Materials & Methods

Outlook in 1949 Unsettled for Materials Supplies and Prices

Is It Cheaper to Buy or Make Parts?

Secondary Metals Now Accepted as of High Quality

Shortages and Costs Force Manufacturing Changes

Intelligent Application of Plastics

Are the H-Steels Being Accepted?

Coordination between Materials, Design and Processing

Materials at Work

Methods and Types of Cleaners for Various Metals

Review of Materials Engineering Developments in 1946

Materials & Methods Manual No. 45

January 1949

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It pays to use your custom molder's know-how

Say the Revere Men in Rome, N. Y.

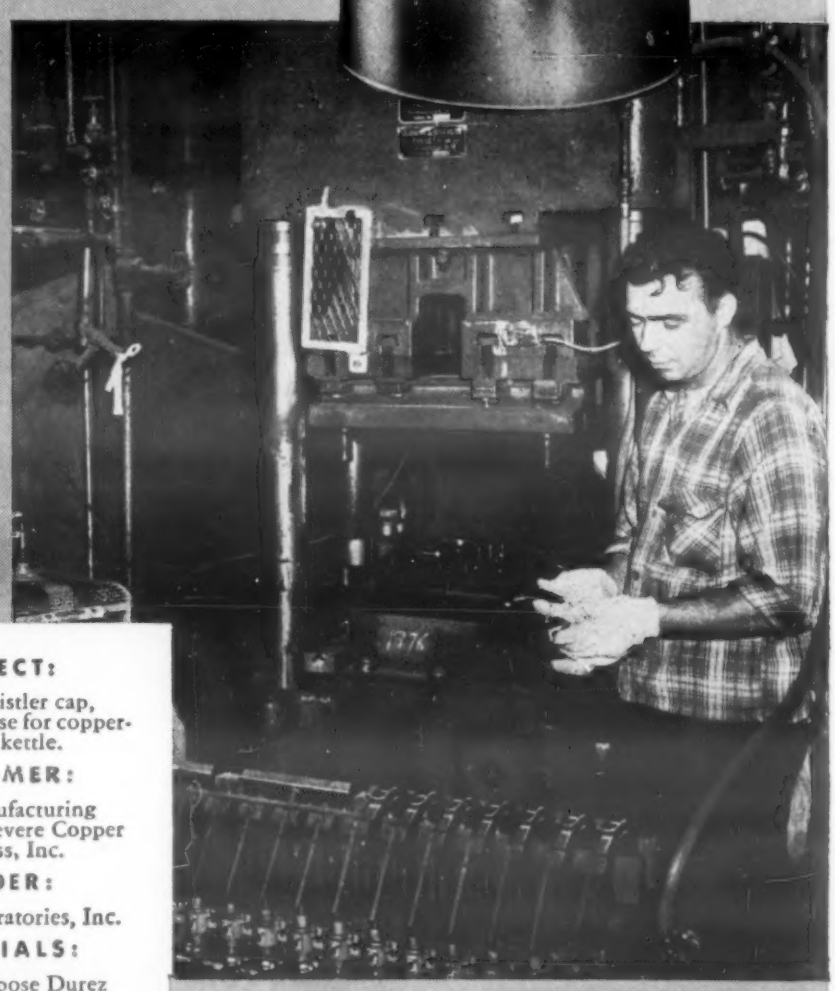
No. 1 in a series on Plastics Skill at work...

PROJECT:
Handle, whistler cap, and finger release for copper-clad tea kettle.

CUSTOMER:
Rome Manufacturing Division of Revere Copper and Brass, Inc.

MOLDER:
Norton Laboratories, Inc.

MATERIALS:
General purpose Durez phenolic in handle, steam-resistant Durez in cap, polyamide trigger.



PRECISION PLANNING improves plastic parts design. Norton development engineer uses vernier height gauge to position front assembly hole on customer's model in perfecting new handle.

CREATIVE ENGINEERING speeds output, lowers cost. Duplex ram plunger press remodeled by molder cuts cure time. Shrink fixture in foreground assures accurate assembly, prevents waste.

● Next time your plans suggest consideration of plastics, why not call in your custom molder early — when he can serve you to best effect?

Example: Tools of a good housekeeper's "dream kitchen", a new line of Copper-Clad Stainless Steel Revere Ware shows the value of having experienced plastics molders cooperate in product development.

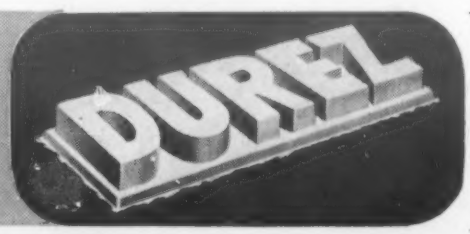
With a good idea ready for the final touches, Revere officials called in Norton engineers. Special skill in custom molding enabled Norton to make constructive design suggestions for product betterment. Then, they devised special production equipment that multiplies output several-fold and assures precision fit in assembly.

Durez phenolics, impervious to boiling water, light weight, and of lustrous, heat-resistant finish, provide desired qualities in the handle and cap.

As specialists in the phenolics since the industry's earliest days, Durez field engineers, too, can bring the authority of experience to your problems.

At any stage in your product plans, from the basic idea onward, we will welcome your invitation to assist.

A new hit with plastics users everywhere is the handy "Durez Check-Chart." Write for yours. Durez Plastics & Chemicals, Inc., 141 Walck Rd., N. Tonawanda, N. Y.



PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- PROTECTIVE COATING RESINS

PHENOLIC PLASTICS THAT FIT THE JOB

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Published monthly by Reinhold Publishing Corporation, 330 West 42nd St., New York 18, N. Y., U. S. A. Ralph Reinhold, Chairman of the Board; Philip H. Hubbard, President; H. Burton Lowe, Executive Vice President; G. E. Cochran, Vice President and Secretary; W. P. Winsor, Vice President; F. P. Peters, Vice President; J. G. Belcher, Vice President; W. F. Traendly, Vice President; Frances M. Turner, Vice President. Price 50 cents a copy. Payable in advance, one year, $2.00; two years, $3.00; three years, $4.00; five years, $5.00 in U. S. and Possessions, Canada and Pan American Union. $2.00 extra for each year in all other countries. (Remit by New York Draft.)
Copyright, 1949, by Reinhold Publishing Corporation.
Printed by Lotus Press, Inc., 508 West 26th St., New York 1, N. Y.
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Reentered as second class matter Nov. 14, 1945, at the Post Office at New York, N. Y. under Act of March 3, 1879.

Established in 1929 as Metals and Alloys.

Materials & Methods®

THE MAGAZINE OF MATERIALS ENGINEERING

VOLUME 29, NUMBER 1 • JANUARY, 1949

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His Signature -- Your Alloy Protection

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RYERSON CERTIFIED STEELS

RYERSON STEEL

The Materials Outlook

Steel makers' worries over sizable production slumps caused by cutbacks in electric power now groundless. . . . Utilities serving major producing centers report periods of peak load past. . . . A few steel producers, operating under reduced power conditions, took cutbacks in stride and sneaked by with little or no appreciable reduction in output. . . . But some aluminum producers haven't fared so well. . . . Winter power curtailments on top of already-short aluminum power supply multiply production difficulties.

Increased offers of steel from ECA countries abroad causing a rising resentment among U. S. steel makers. . . . This feeling understandable. . . . U. S. producers furnish steel under allocations programs to needy countries at expense of regular domestic customers. . . . Aided countries turn around and sell metal back to steel-hungry U. S. customers at large profit. . . . Asking price of sheet runs to $300. per ton.

To combat somewhat similar dealings, curbs against the reported practice of returning ECA aluminum and lead to U. S. consumers at high price levels are under advisement. . . . Warnings may suffice. . . . But reductions in allocations put teeth in it.

Current upsurge in Pacific Coast steel producing capacity focusses spotlight on western scrap supply. . . . Over three times prewar quantity needed for coming year. . . . Extensive drive on to meet this need.

Pig iron supply increasing steadily. . . . and not likely to sag in foreseeable future. . . . Recent decline in foundry melt figures attributed partly to increased pig iron supply; partly to customary year-end slump. . . . But all indications portend a permanent downturn as softening foundry activity spreads. . . . Reduced work-weeks and spotty lay-offs reported in various localities.

Inflexible composition specifications for some aluminum casting alloys can be expected to be relaxed following recent investigations. . . . Minor elements, heretofore considered deleterious in the composition, have been found to actually improve mechanical properties in certain instances. . . . Any alteration of existing specifications could ease supply of aluminum for certain applications by extending use of secondary metal.

Emanating from north-of-the-border is the report that Canadian base metal producers, particularly those producing copper, lead and zinc, have contracted to send regular shipments of metal into U. S. stockpiling warehouses from now until 1953. . . . This strikes one of the most optimistic notes heard in quite some time. Such contracts would lighten the stockpiling load that currently saddles U. S. producers. . . . Would ultimately result in more American metals for civilian use.

And speaking of copper, the question of stimulating production overseas by utilizing credits accumulated through ECA operations has been raised by C. D. Dallas of Revere Copper & Brass. . . . If

(Continued on page 4)

The Materials Outlook *(Continued)*

accomplished, this would increase the supply available to other participating countries and increase supply for U. S. consumption.

Despite the political differences of Messrs. Marshall, Dulles, Molotov, Vishinsky, et al out front, U. S.-Soviet metal trade flourishes in the backroom. . . . Soviet shipments of chromium ore to the U. S. during the first nine months of '48 topped 131,000 tons. . . . And whereas our imports of Russian manganese fell off to 125,309 tons, palladium imports jumped to almost 45,000 troy ounces.

Satisfactory local annealing of steel for drawing operations now developed. . . . Critical areas subjected to severe forming such as small radium fillets, deep draws, or complicated shapes annealed locally prior to press work. . . . Process opens way for increased production rates. . . . reduction of rejects. . . . and uniformly better product design.

Tin controls slated to expire June 30. . . . but will undoubtedly be renewed. . . . OMR stocks building up at steady rate. . . . totaled 44,814 tons on Nov. 1. . . . Increased use in television tube manufacture since close of war causing a stir in video circles over future available supply. . . . Feeling persists that controls could be removed or at least relaxed somewhat. . . . But it's not likely they will.

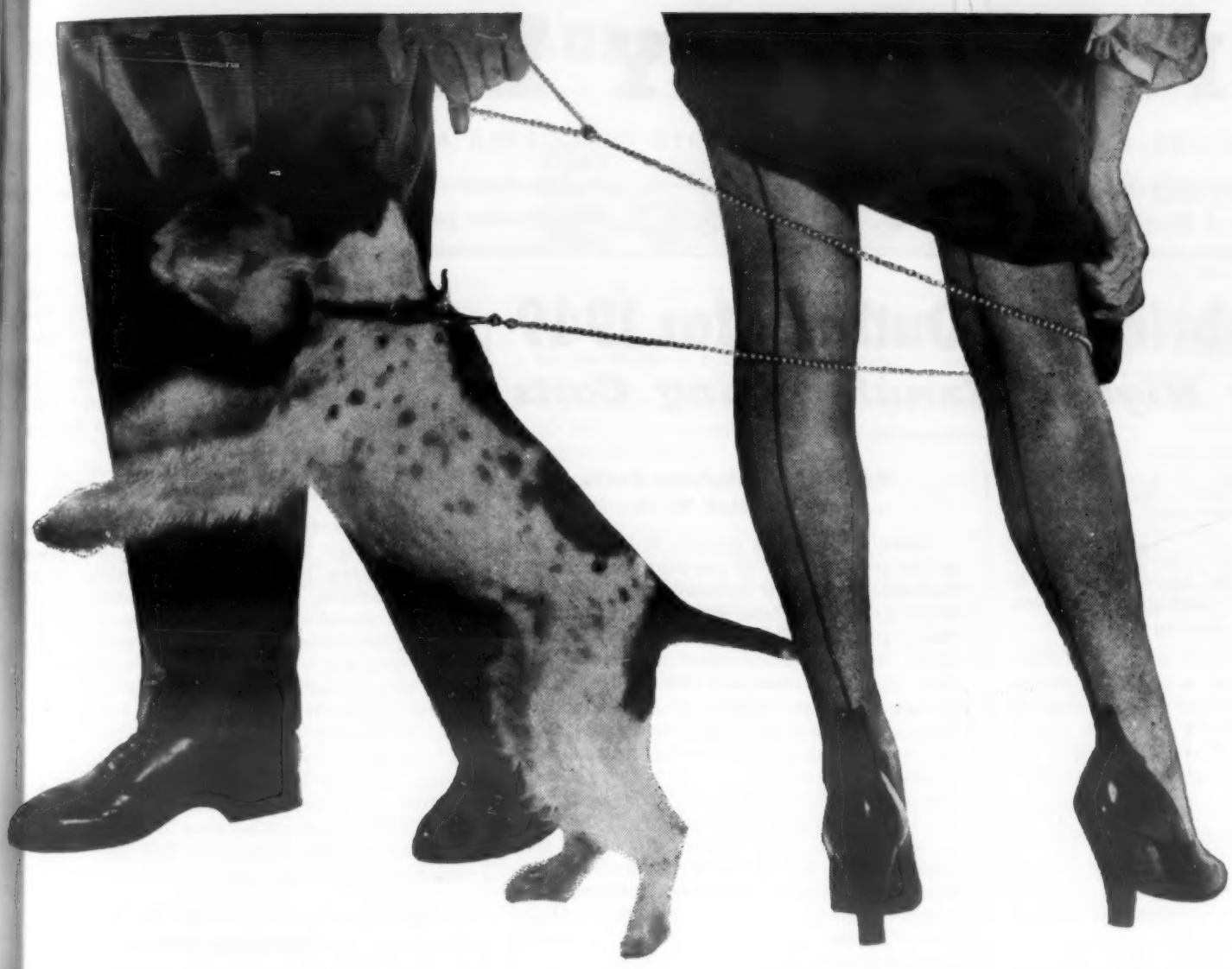
Glowing prediction about aluminum automobiles from pro-aluminum interests (Materials Outlook, Oct., '48) elicits a yawn from oldsters in Detroit. . . . Stevens-Duryea used aluminum bodies with solid aluminum tops in 1902. . . . no wide sheets available then; strips were joined by acetylene welding, and seams worked down with power hammers. . . . Alcoa and Pierce-Arrow collaborated on ten test cars in 1923, each 85% aluminum by weight. . . . steel Pierce weighed 3730 lb. against 3045 lb. for the hybrid.

Titanium is the metal to watch. . . . Current titanium research more widespread than with any other metal or element, barring uranium and its by-products. . . . Facts begin to emerge: Titanium reportedly can be process-annealed by heating in air to 1200 F for 1 hr. . . . Can be forged within 1600 to 1800 F. . . . Has machinability similar to that of austenitic stainless steel. . . . Has excellent corrosion-resistance in sea water. . . . And can be readily spot-welded. . . . Remarkable strength, lightness, and corrosion-resistance will push titanium along faster than any other metal in recent history.

Tungsten and molybdenum, rival alloying elements in high-speed steels, have been racing neck-and-neck in recent months. . . . Third quarter '48 statistics give an interesting picture of their current status: Molybdenum products declined 5% against a 31% rise in tungsten concentrates. . . . But the molybdenum slump reversed an upward trend which had persisted for four consecutive quarters. . . . And the race goes on.

Scattered prices continue to nudge higher. . . . Brass and copper sheets, tubes, rods, and shapes affected in year-end boost. . . . Other climbers: Electrolytic and hot-dipped tin plate, silicon alloys, and ferrocolumbium. . . . But the news is not all bad. . . . Resinous Products Div. of Rohm & Haas announce price reductions for three plasticizers. . . . possibly heralding a downturn in plastics prices.

Of still further plastics interest is the expected over-all increase in productive capacity during 1949. . . . Construction of new plant and equipment slated to boost output to meet continually expanding demands. . . . Unlike the metals picture, no appreciable plastics shortages exist. . . . but increased production is the first step to lower prices.



This should give you ideas

Ever since Bead Chain† was introduced, its use has grown.

But the manufacturer was not satisfied. Still *more* sales could be made if his unique flexible chain were available in a metal that would resist corrosion by marine atmospheres, salt water, high-test gasoline, corrosive factory fumes ... a metal strong enough to be trusted for use as control cables on numerous devices ... a metal that would not rust, would always stay bright and attractive ... a metal that—the list went on and on.

Finally, the manufacturer decided to add another metal to his line. The new chain would be stronger, tougher, corrosion-resisting and rustless.

Bead Chain engineers started their search. Complicating their task was a basic "must"... ductile workability. *(The chain is formed entirely from strip!)*

Investigating all likely metals, they finally selected Monel*. This Inco Nickel Alloy offered all the properties demanded for a hard-service, long-life chain. Its easy workability permitted it to be formed on existing production machinery.

With Bead Chain available in Monel, sales boomed. The dog leash shown above is but one of many new uses. Monel Bead Chain also is used as a retaining chain for the gas-tank cap on outboard motors ... light and ventilator pulls ... control cables ... electric fixture suspension chains ... cable for remote position indicators ... swivels, leaders, leads for fishermen.

† T. M., Bead Chain Mfg. Co., Bridgeport 5, Conn.

INCO Nickel Alloys

Monel • "R"* Monel • "K"* Monel • "KR"* Monel • "S"* Monel Nickel • "L"* Nickel • "Z"* Nickel • Inconel* • *Reg. U.S. Pat. Off.*

"Task Metals" for Industry

EMBLEM OF SERVICE INCO TRADE MARK

DO YOU GET IDEAS *from this use of Monel? Perhaps, like Bead Chain Mfg. Co., you have a metal selection problem. If so, investigate Monel and the other Inco Nickel Alloys. They're real "task metals," ready to take on your tough jobs. Pass your metal problems on to us. Our Technical Service staff will be glad to make recommendations.*

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by Bridgeport Brass Co. "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE and COPPER*

Metal Fabricating Outlook for 1949

Offsetting Higher Manufacturing Costs

What metal problems will confront users of copper and brass mill products in 1949? What will be the effects of high labor costs, tightness of supplies and high prices of raw materials? Answers to some of these questions can probably be drawn from our experiences during 1948.

In an effort to maintain prices of fabricated items, in spite of rising labor costs, raw materials and supplies, fabricators are making a careful study of the many factors involved and have taken one or more of the following steps where possible:

1. Cutting down the number of operations.
2. Reducing finishing costs; extra operations; bad work.
3. Increasing operating speeds.
4. Changing type of operations to reduce finishing costs.
5. Installing more modern, labor-saving equipment.
6. Better work flow and materials handling.
7. Redesigning of product for greater simplification.
8. Reducing maintenance through better materials.

Cutting Down Number of Operations

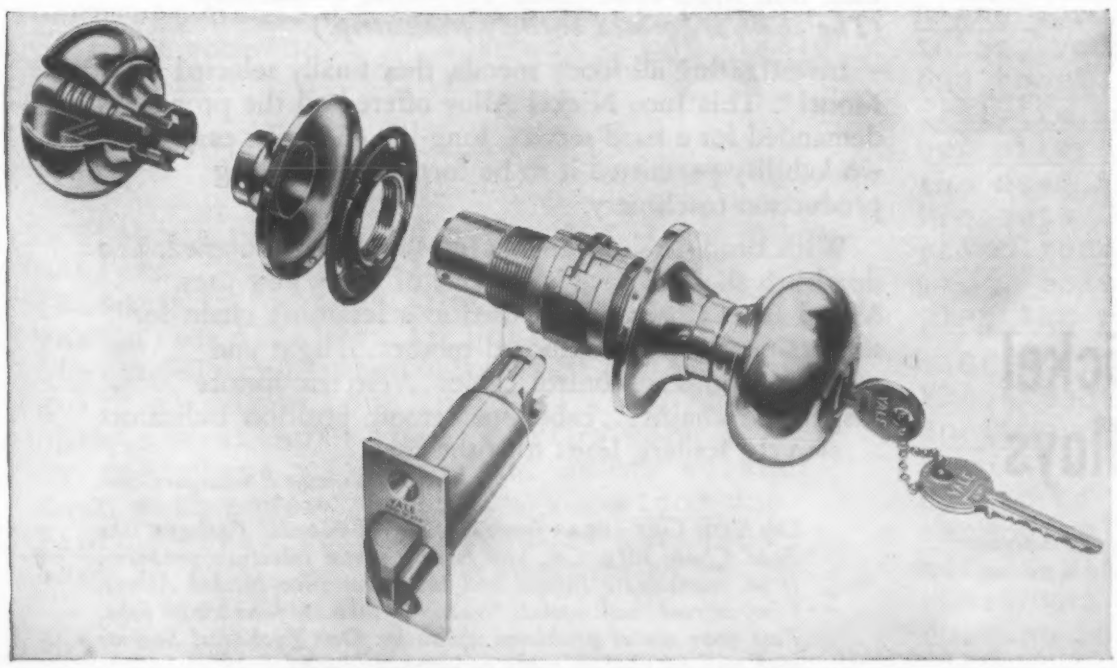
Because brass and other copper-base alloys are much more ductile than those made years ago, it is often possible to increase the severity of drawing operations between anneals, thereby cutting down the number of operations.

Reducing Polishing Costs and Spoiled Work

More attention is paid to finishing costs which involve a large percentage of labor. Careful control of annealing to produce small grain sizes and smoother metal cuts down polishing time. Much can also be done through more careful handling of both raw materials and the product itself during various stages of manufacture. Dents and scratches are expensive to remove and add much to costs and spoilage. Avoidance of tote boxes by battery grouping of operations, specially-designed trays for keeping polished work from denting, good housekeeping, respect for clean, fine surfaces all are helpful measures. Constant watching of excessive scrap and frequent analyses of costs involving expensive "extra operations" bring in unexpected dividends.

Cutting Costs and Improving Quality Through Redesign of Product

Redesign has played an important part in the builders' hardware field to bring down both cost of manufacture and installation by the consumer. For example, large, heavy front door locks with cast brass handles and escutcheon plates are rapidly being replaced by a smaller, lighter but much more efficient product. Door knobs and escutcheons are made from sheet brass by stamping or forming. The new locks are also more ingenious. The lock body is cylindrical in shape, requiring only two drilled holes in the door for rapid and inexpensive installation. Compare this to the old fashioned front door lock, which requires a large mortise by a skilled carpenter. The cost of installation was often higher than the price of the lock itself! Redesign of the product is, of course, helping other industries to increase sales appeal and often to reduce cost of manufacture.



Redesigned for modern styling and economical installation, the new Yale heavy-duty tubular lock is packed in pre-installation units. Double thickness of strip brass in the door knob prevents denting. Streamlined wrought brass escutcheons have replaced castings. Courtesy Yale & Towne Manufacturing Company, Stamford, Connecticut.

Increasing Operating Speeds

Many manufacturers have succeeded in speeding up their machining operations by changing to a free-machinable alloy. For example, the use of leaded Naval Brass instead of regular non-leaded Naval may double machinability without greatly affecting the strength or corrosion-resistant properties. Longer tool life and faster cutting speeds for tough alloys can often be attained by using the correct tool shape, a change to carbide or other harder tool materials, or by using the proper lubricants or coolants, which quickly draw away the heat generated by the cutting operation. Our laboratory has helped customers greatly in this respect.

Change in Operations to Reduce Finishing Costs

Change in methods of fabrication of the product may bring appreciable economies. One manufacturer, tired of the excessive cost of polishing rough sand castings of brass, redesigned the part by using a number of screw machine parts made from free-turning brass rod, which could be polished on automatic equipment. Another evolved a method of making a part from tubing by cold forging without changing the physical appearance of the finished part appreciably. This item had been made from sand cast brass for many years.

Changes from castings to hot and cold forgings have also taken place. Aside from lower finishing costs, a better article is often made from wrought metal as against a casting, doing away with the problem of poor castings, porosity, and rough surfaces.

Better Work Flow and Materials Handling

Rearrangement of machines and equipment to eliminate awkward handling; integrating departments to avoid unnecessary transportation from one room to another; more liberal use of modern conveyor systems and methods will increase production and cut labor costs. In fact, any speed-up of scheduling which will reduce the time of fabrication will bring savings resulting from more rapid turnover of investment. *(Continued on next page)*

1948 Index in Preparation

Get your copy of the Annual Index to the Copper Alloy Bulletin by writing to Bridgeport Brass Company and asking that your name be added to the Copper Alloy Bulletin mailing list. Those already on the Bulletin mailing list will automaticaly receive copies, now in preparation.

METAL OUTLOOK

(Continued)

Reducing Maintenance by Using More Corrosion-Resisting Metals

Corrosion, the enemy of all metals, is finding more opposition from copper and its alloys. Destruction from corrosion means expensive maintenance, shutdowns, repairs and eventual replacement, all of which involve high labor costs. As a result, more attention has been given during the past year to specifying more corrosion-resisting alloys and combinations of metals. This explains the unprecedented demand for copper tubing for plumbing, heating and refrigeration lines, and for water wells. Copper tubing is also replacing outworn, rustable underground gas mains.

Outstanding is the large increase in the use of Duplex Tubing – copper-steel for ammonia refrigeration and for the handling of nitrogen compounds. Much saving has been effected over steel tubing because of increased service life, better heat transfer and reduced maintenance. Other combinations of Duplex Tubing are doing much for the processing of petroleum products, chemicals and foods.

Serious pollution of streams and harbors is responsible for a wider use of corrosion-resisting Duronze IV* (aluminum bronze) and Aluminum Brass condenser and heat exchanger tubing in the power, marine and chemical fields.

To fight corrosion from moisture and weather we find that manufacturers are using more silicon bronze alloys for bolts, nuts, screws, marine and pole line hardware, equipment for waste treatment and sewage disposal plants, paper mills, etc. Duronze III* (silicon aluminum bronze) and other aluminum bronze alloys are also more generously used for valve stems, pump parts, valve seats to reduce wear and increase service life.

To sum up briefly – metal fabricators are meeting rising costs by more carefully selecting metals and alloys that are physically suited to their requirements as exactly as possible, are tightening up on their manufacturing operations, and changing methods of manufacture for greater economy.

Progress at Bridgeport Brass

Many gains have been chalked up on the plus side of the ledger. 1948 was a high production year for the Company. At Bridgeport, Connecticut, the mills worked at capacity practically all of the time. New production records were made by our Tube Mill as more and more of the new equipment swung into action.

Our new mill at Indianapolis also greatly benefited from the additional equipment which made possible the production of commercial gauges of strip and sheet and a full range of rod sizes and shapes. Its substantial volume of copper water tubing in straight lengths and coils also helped its growing production picture. Thanks are gratefully extended to our Mid-Western and Western customers for their support rendered to this great new mill.

With many unsolved problems at home and abroad, 1949 promises to be a year of changing conditions. Customers should feel free to call upon our laboratories in Bridgeport and Indianapolis, as we wish to be as helpful as possible in regard to their metal problems. *Reg. U. S. Pat. Off.

For fabrication of the many thousands of articles of everyday use, Bridgeport offers a wide choice of alloys in many forms. Modern mills in Bridgeport, Conn., and Indianapolis, Ind., and a staff of experienced laboratory-trained men are ready to help our customers quickly with their metal problems.

Sheet – Rolls, Strips – Brass, Copper, Nickel Silver, Phosphor Bronze, Silicon Bronze, Aluminum Bronze for drawing, spinning, stamping, forming.

Rod—High-Speed, Free-Turning Brass and Duronze III Aluminum Bronze for screw machine operations. Also, Naval Brass, Silicon Bronze, Aluminum Bronze. Bronze Welding Alloys.

Wire—Brass and Silicon Bronze for making screws, rivets, bolts, nuts, nails. Phono Electric Bronze trolley wire.

Tubing—Copper for plumbing and heating; Condenser and Heat Exchanger Tubing; Brass and Copper pipe.

Plumbing Brass Goods. Traps, sink plugs, basket strainers, bath wastes, basin supplies, shower curtain rods; radiator air valves for one-pipe steam heating systems.

Automobile Tire Valves – for passenger cars, trucks, farm tractors – valve caps, cores, gauges.

Aer-A-Sol Insecticide—DDT pressure container type for killing household insects.

NEW DEVELOPMENTS

This column lists items manufactured or developed by many different sources. None of these items has been tested or is endorsed by the Bridgeport Brass Company. We will gladly refer readers to the manufacturer or other sources for further information.

Circular Slide Rule, only 4½" in diameter, can be used to multiply, divide, determine squares, square roots, cubes, cube roots, reciprocals and proportions. **No. 901**

Automatic Loading Devices for rotary and rack type gear finishing machines are said to maintain production rates as high as 300 pinions per hour per machine by means of gravity chute feed, eliminating need for arbors to mount gears and pinions. **No. 902**

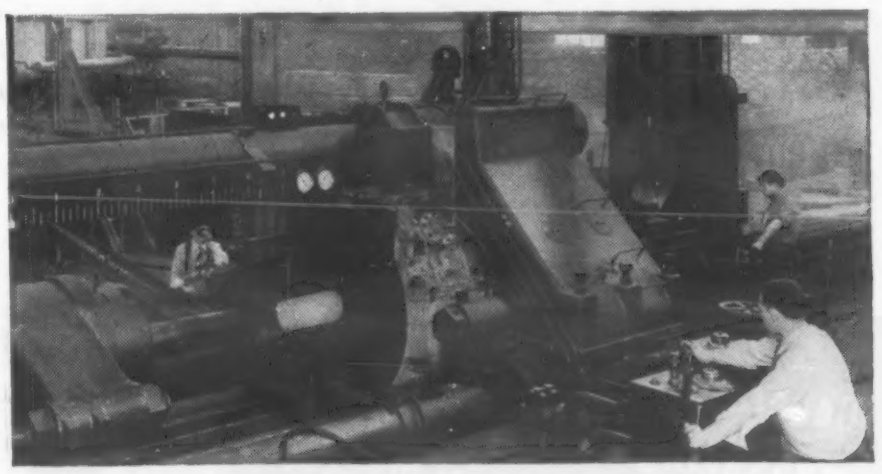
New Miniature Lathe is said to combine features of standard lathes with specialized design of jewelers' lathes for use in machine shop, tool room and laboratory as well as by watchmaker and jeweler. Measures 10½" x 7¼" x 3¾", with speed range from 100 to 3000 rpm. **No. 903**

Vernier Scale Magnifier, essentially an optical glass 3½" to 4 power lenses in spring brass frame, clips over head of reading scale to simplify accurate reading on both sides of vernier calipers. **No. 904**

New Metal Castings Sealant is reported to permit salvage of many castings rejected due to porosity. Impregnation is by vacuum pressure method, suitable for aluminum, magnesium, bronze, steel and gray iron, it is claimed. Anodizing or plating coatings can be applied, and sealant resists hydrocarbons, water, salts, solvents and moderate acids or alkalis. **No. 905**

Self-Feeding Tube Expanders are claimed to provide uniform expansion through entire thickness of sheet. Designed for precision rolling of condenser tubes from ½" to 1½" od, units are said to be particularly effective in rolling bimetal tubes. **No. 906**

Pocket-Size Plater's Computer is said to furnish data quickly for all types of plating operations, such as plating time to deposit given thickness of metal, current density required to deposit given thickness, thickness resulting from established plating time at known current density, cathode efficiencies of plating solutions, etc. **No. 907**



Indianapolis Plant of Bridgeport Brass—powerful 3850-ton extrusion press making brass rod from a red hot billet.

BRASS, BRONZE, COPPER, DURONZE, NICKEL SILVER, CUPRO NICKEL

"Bridgeport" BRASS CO.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

Warehouse Service with Slitting Facilities in Principal Cities

1/10 second to wink...

1/50 second is average shutter speed..

NOW you can catch all speeds from 1/10,000 to 3 seconds

WITH THIS GE TIME INTERVAL METER

How to determine the speed of camera shutters as they rolled off the production line? How to do it quickly and accurately?

That was the problem faced by Graflex, Inc., of Rochester, N. Y. The method formerly used to determine these speeds was to take photographic exposures of the shutters in action. This accomplished the quality-control test satisfactorily. But it was slow and expensive! And the job was a manual operation. In the second place, developing the film took time!

The problem was given to General Electric. The result was a time interval meter . . . an instrument that measures time interval speeds 1000 times faster than the wink of an eye.

This gave Graflex a new quality-control instrument . . . an instrument that did the job faster and saved money.

But its use didn't stop here. Many of these equipments soon found their way into other industries . . . industries where the problem was measuring time intervals.

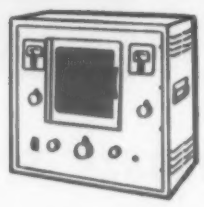
General Electric engineers have helped solve thousands of such problems for industry. Frequently, the result has been a new testing and measuring equipment. Equipment that today is saving time and money for industry!

Your problem may justify a development program to create a new product, particularly if the problem is a common one. Or, maybe, our engineers can recommend an instrument from the many testing and measuring equipments already available . . . proved equipments that are doing jobs on problems similar to yours.

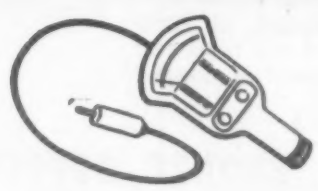
Write us about your problem. Maybe we can help you.

Apparatus Dept., Section F 800-42,
General Electric Co., Schenectady 5, N. Y.

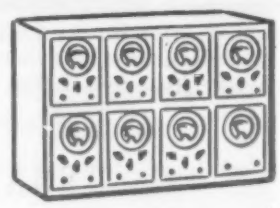
General Electric testing and measuring equipments for nearly every industrial process . .



Resistance and Insulation Testing Equipment



Time, Speed and Torque Equipment



Force, Strain and Thickness Gages

EDITORIAL

An Announcement by the Publisher

T. C. Du Mond

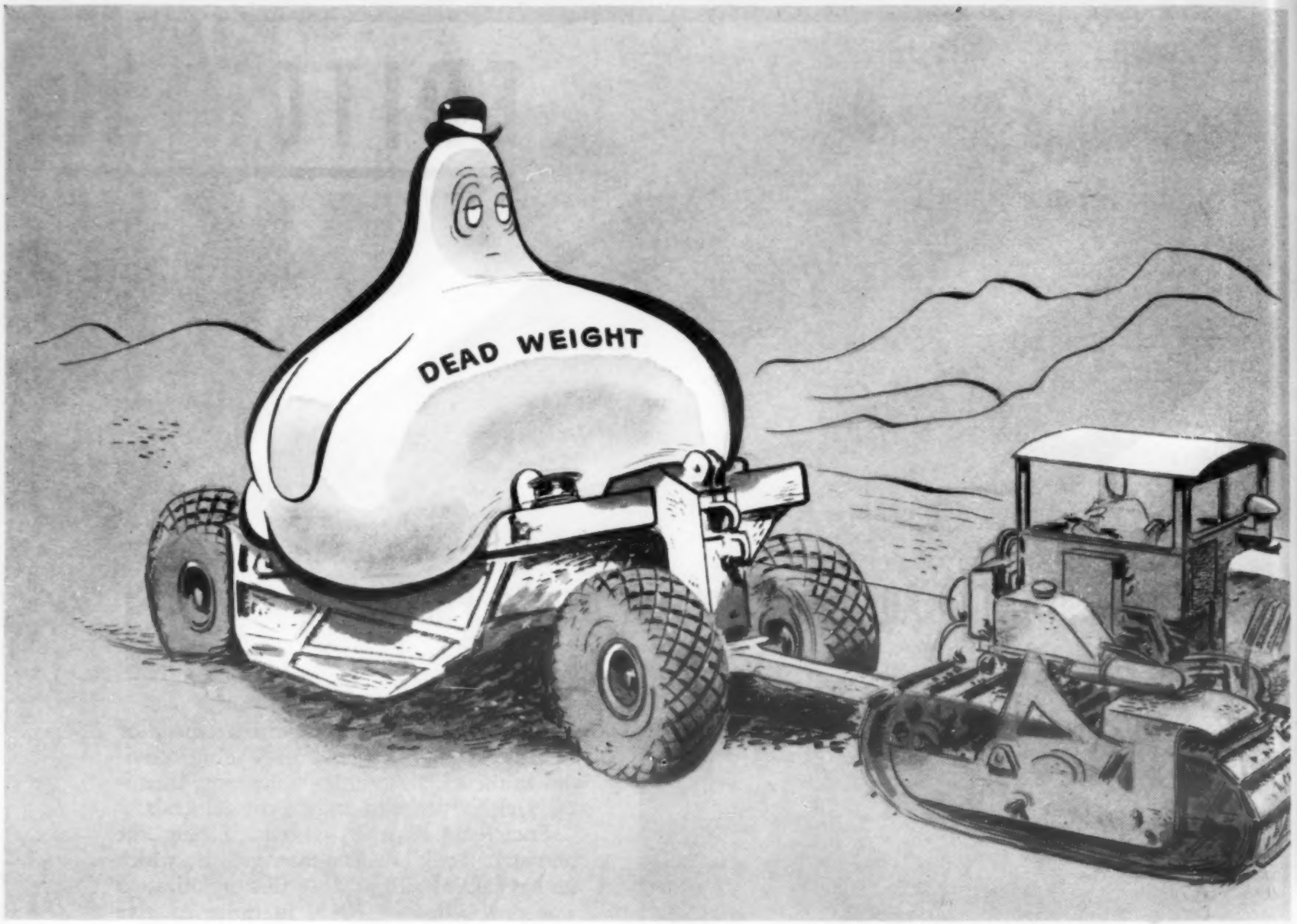
Reinhold Publishing Corporation, publisher of MATERIALS & METHODS, is pleased to announce changes in the management of certain of its departments which will be of direct interest to readers of this magazine.

Fred P. Peters, who joined the paper's editorial staff in 1936 and has been editor-in-chief since 1943, has been made a vice president of the Corporation and publishing director of its Book Division. He will, however, continue to be actively associated with MATERIALS & METHODS, as editorial director, dividing his attention between the magazine and the general management of Reinhold's extensive book publishing activities in the metallurgical, engineering, chemical, architectural and other technical fields.

Francis M. Turner is relinquishing the burden of Book Division management, which he has carried almost since this organization was established in 1915, in order to give special attention, as a vice president of the Corporation, to initiating and developing important book publishing projects.

T. C. Du Mond, who has been managing editor of MATERIALS & METHODS since September 1945, assumes the position of editor and will be in full charge of the magazine's editorial program from now on. Mr. Du Mond, 38, is a mechanical engineering graduate of the University of Cincinnati. Before joining the M&M staff he served in engineering and editorial capacities with George Gorton Machine Co., Westinghouse Electric Corp. and *American Machinist*. He has been personally responsible for many of the recent improvements in MATERIALS & METHODS that have made it one of America's outstanding engineering magazines, both in technical content and typographic format.

Those who know Mr. Du Mond personally, those who have heard his stimulating and instructive talks given in various cities, and all who have read his many articles and Manuals published in these pages, will join us in affirming that the field of materials engineering will be eminently and ideally served through his editorial leadership in it.



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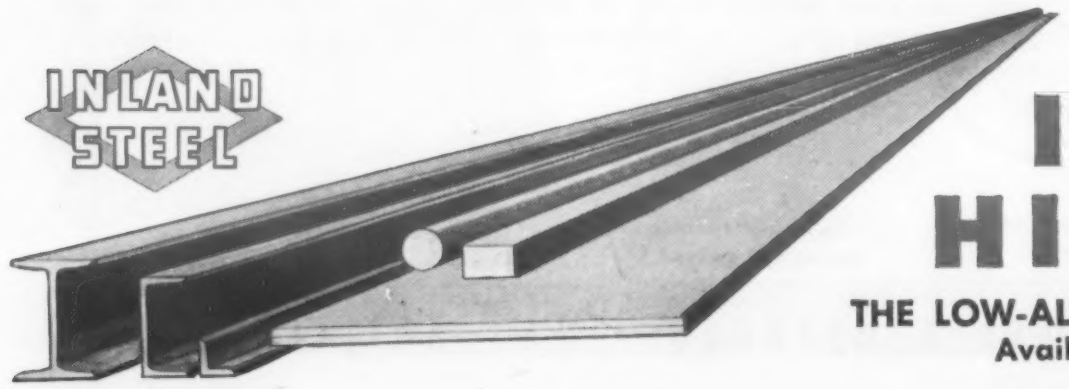

INLAND HI-STEEL

THE LOW-ALLOY, HI-STRENGTH STEEL
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Contributing to other shortages is a lack of sufficient electric power. The demand continues for generating equipment. (Photo: Courtesy Westinghouse Electric Corp.)

Outlook in 1949 Unsettled for Materials Supplies and Prices

by **N. B. BAGGER**, Associate Editor, Materials & Methods

Materials, almost universally in short supply, will probably stay tight during 1949, and prices may go higher. Stockpiling, ERP, and tremendous consumer demand prevent any immediate slackening of demand, but uncertainties abound, and, in some isolate instances, the picture is already bright.

• A LARGE QUESTION MARK hangs suspended over the coming year in the minds of both materials users and producers. The events of the past twelve months have done little to allay the doubts, the uncertainty, and the general uneasiness that permeate the materials picture today, and at this writing, all signs point to a continuation of this unsettled state for at least the better part of the year to come.

The current uncertainty that is generally prevalent throughout the materials field springs from an apparently paradoxical set of circumstances: With materials production records being broken almost without exception, and in the midst of one of the biggest booms in history, we are continually beset with severe shortages in almost every material line. The answer to this, of course, lies in the fact that demand has so far outstripped available supply that the normal balance between these two factors has been wrecked. In the midst of this wreckage lies the remains of a normal, competitive price structure. Allocations, stockpiling, and foreign aid programs have contributed no small part in the creation of this chaotic unbalance. And the big question remains: Where do we go from here?

There is no single, blanket answer to this. So many factors have contributed to the forming of the question that all must be considered and analyzed before an answer can be had. And even then, the net result

is uncertainty because the entire picture could conceivably change in a very short length of time. A decided shift in any one of the supporting factors would have a kaleidoscopic effect on the over-all pattern as it appears today. Such a shift would, in turn, affect other factors and an entirely new set of conditions would be brought into play.

The recent Presidential and Congressional elections have been followed by much conjecture as to what the new Administration will do, since Washington plays a major role in the materials situation today. The outcome of the basing point vs. f.o.b. pricing system controversy will, of course, affect materials costs and supplies in many sections of the country. If the f.o.b. system continues, certain localized areas distant from producing centers may possibly cut back on requirements, not wishing to continue paying high freight rates. This could result in excess supplies to the areas near producing centers. On the other hand, a return to the basing point system could materially affect over-all supplies by increasing the already-high costs of the materials producers. Increased corporation taxes may also be passed during the next Congressional session. These might tend to reduce production on its present scale and ultimately result in an increase in gray or black market activities. The effects of such legislation on the materials picture are evident. And the possibility of its becoming fact contributes to the widespread uncertainty as to the future that is prevalent today.

Allocations and stockpiling programs give every indication of continuing to expand, and together with increased aid to foreign countries, portend an even tighter supply of materials for domestic consumption throughout the coming year. Predictions of an early cessation of stockpiling appear now to be very remote, and there is but slight chance that contracts terminating June 30, 1949, will be eased upon renewal. In this connection, however, it is encouraging to note the gradually increasing stream of foreign ore shipments to this country from nations abroad. This, small as it is, proves to doubters that our present policy is not entirely a one-way street. As a matter of fact, the shipment of African gold coast ores to the United States is slated to increase considerably toward the latter part of the year as British transportation facilities continue to improve. To further this, if possible, it might appear beneficial to our interests to furnish any equipment needed for this undertaking so as to speed shipment of the materials.

The railroad industry continues to need enormous quantities of equipment. Shown here are a variety of railway springs at the Spring Works of Crucible Steel Co. of America.

Another factor augmenting the over-all uncertainty of the materials situation is labor. Fourth-round wage increases are definitely in line for action during the first half of the coming year as present contracts expire. These increases, possibly accompanied by widespread strikes, and both with the official blessing of revised labor legislation, cast a further shadow on the already cloudy vista. It is likely that work stoppages for one reason or another will continue to plague materials producers throughout the coming year. And it is almost a certainty they will have increased labor costs. The result, obviously, will be continuing high or higher prices to materials consumers.

The last, and possibly the biggest factor affecting materials costs and supplies, is that of ultimate consumer demand. As production pipelines gradually fill and the market for certain products becomes saturated, consumer demand inevitably drops. This has a cumulative effect on the supply and demand for other products. The materials that are no longer required for production of the saturated product are diverted to other fields, where they aid in easing acute shortages. There is already evidence of this taking place in certain lines, and the trend is definitely toward a continuation of this during the coming year. But the extent to which it will go is another unknown in the over-all, uncertain picture.

Thus, from this broad summary, let us consider individual status of each major metallic material for the year ahead.

Steel

The steel situation as we enter the new year presents a far from alluring picture. It is largely a case of producers trying to keep up with commitments, with the total steel demands excessively greater than current output. Some mills, in an effort to clean up all 1948 commitments by the end of the year, had to reduce quotas during the fourth quarter to break even with the calendar. But the results were not entirely satisfactory. Uncertainties of allocations programs are labelled as the primary cause of scheduling difficulties, with

To relieve shortages, most steel companies have added to production capacity as in this Carnegie-Illinois Steel Corp. mill.

Here is one of the newest reduction plants of Reynolds Metals Co., which seeks to provide additional aluminum.

a result that month-to-month scheduling appears to be the order of the day.

The continuing tendency of various consumer groups to seek preferential treatment from the Government in regard to allocations is further aggravating this already serious problem. Although the total amount of steel under allocation is currently relatively small in relation to total output (about 10% of finished steel production), each additional allocation must, of course, be made at the expense of non-allocated groups. Thus, charges of favoritism, some not unjustified, are the outcome of the same weaknesses in the allocations system that were pointed out by steel men before the programs were set up.

Voluntary allocations, undertaken with the blessing of Public Law 395, will be prohibited when that law expires on Mar. 1, 1949. But new programs directly related to national defense could be operated on a mandatory basis after the law expires under provisions of the Selective Service Act of 1948. The cut-off on new programs does not preclude possible continuation for six months beginning Mar. 1 of the more essential programs now underway, since the law permits programs that are in operation to continue on a unilateral request basis for a period of up to six months. However, in view of a reported stiffening attitude on the part of the industry to further voluntary allocations, it appears inevitable that Congress will legislate more stringent controls over steel distribution.

In the light of all this, little if any improvement in supply is indicated for the months ahead. At least there is small hope of boosting the amount of steel to consumers for non-allocated requirements. This apparent over-all trend toward heavier allocations gives no promise of abating. It is expected that by mid-1949, again barring unforeseen developments, allocated tonnage will be even greater than is currently estimated. This is further pointed up by the increasing emphasis on domestic rearmament plans and the rising tempo of ECA demands.

Price-wise, the outlook for steel is dark. Current mill prices are predicated on costs that have tended upwards even since the general steel price advances of last summer and the spotty adjustments of last fall. And the pressure shows no immediate signs of easing. Still higher steel prices are definitely not an improbability if freight rates go up. Any further rise in the current high cost of living will most assuredly be reflected in increased labor costs when new wage contracts come up for negotiation this year. All these factors can, and most likely will, have a deleterious effect on the price you pay for steel during the coming year.

A return to the basing point system has been advocated by an increasing number of steel consumers. The gist of their argument is that the present inequities of the f.o.b. pricing system far outnumber the advantages they supposedly derive therefrom. This is under advisement at the present time.

Pig Iron

Pig iron supply continues to plague steel makers and foundries—and will for some time to come. At the close of the war, some authorities foresaw a five-year pig iron supply stringency. Allocations have borne out their predictions. But in spite of this, interest in foreign pig lags. This is attributable partly to the high cost of imported iron, and partly to the fact that some of the pig received from abroad has been of questionable quality. The spotty increases in pig prices seen early last fall have now become fairly general, advances having averaged $3.00 a ton in most instances. Again, the possibility of higher freight rates would be a potential influence for higher pig prices later this year.

On a more cheerful note for a change, scrap markets are showing further signs of relative stability as the flow from overseas increases. It has taken some time for these effects to be felt in the inland areas; the Eastern seaboard having grabbed off the imports almost before the ships docked. But it is expected that as more frequent cargoes of foreign scrap arrive, the inland mills will gradually be able to get their fair share.

Reports continue to come in that the peak in scrap values, for the steelmaking grades, has been reached. But there are no indications as to when prices will decline. The present high rate of scrap consumption, plus the relative tightness of pig iron supply, are both factors that hinder any immediate price yield.

Copper

The nonferrous metal picture looks

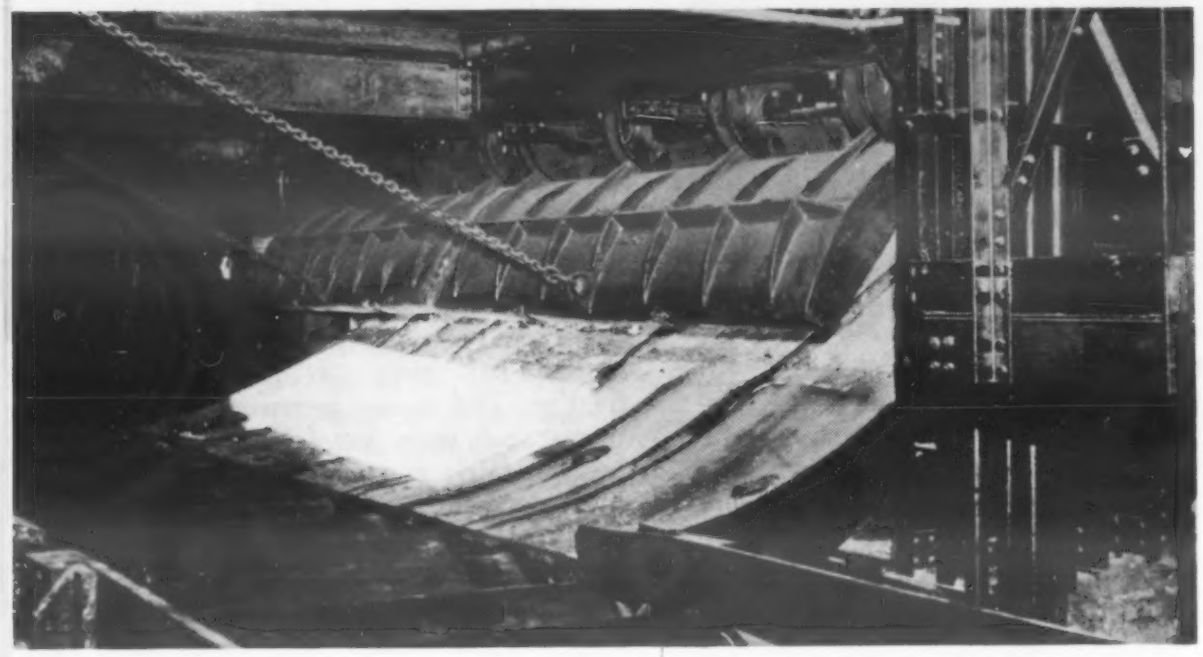
fair. Although the United States is currently the world's largest mine producers of copper, lead and zinc, it is also a large importer of these same three metals. This lack of self-sufficiency is, of course, attributable to the tremendous rise in consumption that has taken place. Many peacetime records for the consumption of copper and copper-base alloys were broken during 1948. The most notable of these, according to the Copper and Brass Association, being the use of nonferrous forgings. These have increased 400%; while the use of copper tube for hot and cold water lines, waste and vent lines, radiant heating, and for gas lines is far greater than the peacetime consumption during any prewar year.

The deficit in domestic mine production is further advanced by the current Governmental copper stockpiling goal of 90,000 tons by June 30, 1949, and the financing of sales of copper to countries under ECA. These increasing ECA demands portend some complications in copper authorizations early this year.

In a political attempt to alleviate this tight situation, Congressional efforts were made to pass the Patterson Bill (H. R. 7152) calling for a suspension of copper tariffs until March 31, 1952. But this died in a pigeon hole in the Ways and Means Committee. At the present time, Public Law 42 suspends the tariff until Mar. 31, 1950. However, it is expected that the new bill will be reintroduced and passed during sessions of the new Congress. Outright repeal of the copper tariff has been favored for some time by some domestic copper consumers, at least while the present supply situation exists. But stiff political opposition has prevented such action to date.

In spite of this, unless something unforeseen occurs, there should be a sufficient supply of copper ore and brass mill products to meet the demand of peacetime industries in the United States during 1949. The mines in this country and those owned by American capital in Mexico and South America are operating at full capacity, and barring further strike situations such as that encountered at the Utah properties of Kennecott, the over-all output in 1949 should be sufficient to meet most requirements.

The price of copper and copper-base alloys won't go much higher—now that recent boosts have taken hold. The strikes and speculative activity in copper scrap that have aggravated the supply situation in recent months will probably continue. But there is little indication of any further change in the domestic market from the present level. In this connection, it is of interest to note that the advance last fall in the British Government's maximum price of electrolytic copper to £140 per ton, equivalent to 22.15¢ per lb., delivered to consumers' plants in the United Kingdom, did not create much of a stir in the American market. This is a far cry from the old days when a rise or fall of a few shillings in the London market was regarded throughout the world as an important development.



Despite record steel production, there is no indication of an immediate meeting of industry's demands.

Lead

A somewhat sorrier story holds true for lead. Output continues tight, and demand still runs well in excess of available supplies. The long strike at the Southeast Missouri properties of the St. Joseph Lead Co. last summer and fall, among others, considerably hindered the over-all supply situation and, in part, caused premium lead from foreign sources to be offered in New York at comparatively high levels—even for import. Although increased sales resistance and resumption of St. Joe production caused a spotty decline in the price of foreign lead, the so-called premium prices remained disproportionately above the domestic market level at year's end.

If there are no major strikes during 1949, domestic lead production should be about 25,000 tons more than in 1948, with an additional moderate increase to be expected because of exploration and development work, delayed by the war, and not caught up. The supply of lead from scrap should be about the same or slightly less during the coming year. It can be expected that imports will be somewhat larger because of moderately increased foreign production and probably somewhat reduced demands abroad. All in all, the supply of lead should be slightly better in 1949 than it was last year.

But despite this generally more favorable supply, the over-all lead outlook for 1949 appears now to be a continuation of the shortages which existed through 1948, particularly in view of the fact that Munitions Board stockpiling goals call for 70,000 tons of lead by June 30, 1949. The Board has contracted for 19,000 tons of this, with 51,000 coming from the industry on an individual contract basis rather than through a voluntary allocations program. On the other hand, even if the Government should hold off in its purchases for awhile, it will undoubtedly step in whenever there appears to be either a near balance between supply and demand or a surplus of lead. Thus, there is little likelihood of any weakening in the lead market during the coming year.

The increases in the price of lead so far have had relatively little effect in the over-all consumption, although some effect is now beginning to be seen in such industries as the paint and collapsible tube fields where reasonably satisfactory substitutes may be found. Further increases in prices, which are certainly not beyond the realm of possibility, might further discourage consumption and hasten the balance between supply and demand. But, again, if such should be the case, Governmental purchasing would absorb any surplus.

Zinc

The supply of zinc also tightened steadily throughout the past year, what with increased consumption and Government stockpiling programs. Particularly in Prime Western and Special High Grade, domestic demand remained brisk up to year's end. Every indication points to this continuing during the coming year.

Following some split-price confusion incurred last fall when in two jumps, Prime Western advanced to 17.5¢ East St. Louis, the industry fell in line and the new price was established on the basis of substantial tonnages, sold on a firm price basis. But even now, there is no guarantee that this level will hold during 1949. At this writing, pressure is already building up for another price advance. And Munitions Board stockpiling objectives, calling for 60,000 tons of zinc through June 30, 1949, on a voluntary allocations program, do not give promise of any increased supply or lower price in the near future.

Tin

The regulatory orders M-43 and M-81 that blanket uses of pig tin do not show many signs of being lifted or relaxed right away. Munitions Board contracts during July-Sept., 1948, called for 4500 tons of pig tin to be delivered before June 30, 1949. This is claimed to be the presently anticipated total amount to be purchased for the stockpile during the fiscal year ending June, 1949, for delivery prior to June 30. At the rate RFC stocks are growing, it would appear that at least a 10% rise in allocations to consumers could be made without unduly disturbing the Government's stockpiling program. The scarcity-minded Washingtonians have not been subjected to much lobby-pressure in this connection, but the industry feeling still persists that a more liberal treatment is in order.

However, all this notwithstanding, hopes are still high for an increase in tin mill production during the coming year. Predictions of possible expansion in output this year range up to seven million base boxes. But to reach this, additional changes in product mix will be required, with black plate and electrolytic enjoying greater use.

Steps in this direction were taken last year by the use of 0.25-lb. electrolytic in beer cans. Regulations prevented manufacturers from using any more pig tin in 1948 then they did in 1947. To abide by this ruling and still meet increased production goals, one maker used 0.25 lb. electrolytic for the entire can; others used this coating material for the can ends and used 0.50-lb. for the bodies.

The first potential set-back to this year's plate production goal is the planned four-to-six-week shutdown of Inland Steel's Indiana Harbor tin plate operations during the first quarter of 1949. This is expected to result in a loss of 15,000 to 20,000 tons. The shutdown is scheduled in connection with the company's cold-rolled expansion program.

So, with everything considered, as long as current stockpiling, regulatory controls, and heavy demand continue, the supply of tin will continue very tight. Prices are not expected to exceed those recently announced by two major suppliers for the coming year: Electrolytic tin plate ranging from $6.45 for 0.25-lb. coating to $7.10 for 0.75-lb. coating per base box of 100 lb. basis weight at producing point.

Magnesium

Magnesium appears to be one of the few metallics slated to enjoy comparatively smooth sailing during the coming year, price and supply considered. At this writing, no price change is foreseen during 1949. The availability of magnesium is theoretically unlimited as it is not dependent upon deposits, ores or such. However, processing and fabricating facilities may prove gradually tighter during 1949 and on into 1950 as still newer uses and applications develop. This might well be the case, particularly if a worsening international situation prods the Government into increased appropriations for military equipment. Barring this, though, magnesium has a fairly clear field and reasonably good stocks on hand for the coming year.

Aluminum

The aluminum picture resolves into the now-familiar pattern: output unable to keep up with demand. But a fundamental difference occurs. Whereas production of some other materials is currently limited by plant capacity or size of working force, the aluminum industry is falling behind in its attempt to meet demand primarily because of the electric power situation. According to the Aluminum Association, the first requisite for more aluminum is more power. But the power must be low in cost so that the metal can be produced cheaply enough to permit its large-scale use in the apparently ever-expanding civilian and military applications. During 1949, aluminum was produced at the annual rate of 1,300,000,000 lb., or about four times the prewar average. At year's end, this was abour 500,000,000 lb. short of the current civilian demand.

From this, conservative estimates indicate that, with aluminum becoming more firmly established in new uses, the shortage will reach 750,000,000 lb. by 1952 unless production is increased. The acuteness of this situation is further accentuated by the fact that the surpluses of aluminum that were available at the close of the war have long since been exhausted, and the demand for the metal can now be met only by new production.

From this, it is apparent that both primary and secondary aluminum will continue tight throughout 1949. Current ECA commitments, continued expansion of civilian applications, and the probability of further Governmental purchases for military uses, all preclude any possibility of a softening supply. Price-wise, the market will probably rock along in its present course. But the possibility of further rises should not be overlooked; particularly if increased freight rates, new round wage hikes, and/or all-out Governmental purchasing takes hold.

Nickel

Nickel is still another material currently caught in the squeeze between high demand and short supply. And this condition is expected to continue well into the coming year. Governmental acquisitions totaled 15,000,000 lb. by Dec. 31, 1948. If this should satisfy stockpile requirements for the time being, there is some liklihood that supply will ease slightly toward the latter part of the year. But if stockpiling continues throughout 1949, there will be no appreciable let-up in the already-tight supply. The recent nickel price jump will probably prevent any further boost in the near future. But a leveling-off is the best that can be expected. Decreases cannot be anticipated under present conditions.

From this discussion, the over-all uncertainty of the materials situation can be easily seen. The contributing factors and their inevitable interdependence combine to make any more definite type of forecast extremely impracticable. But with everything considered, the conclusions as stated are the way the materials prices and supplies appear at the present time.

Buying or making product components should depend on accurate analysis of materials, design, cost, and fabrication factors. Rules-of-thumb do not apply.

Is It Cheaper to Buy or Make Parts?

by **ALVAH I. ROOT**, The Stanley Works

● DURING THE COURSE of manufacturing products for sale, the question of parts-purchase vs. parts-manufacture inevitably arises. It is generally not an easy one to answer. The choice of making certain component parts or buying them from outside suppliers involves a consideration of many factors before a justifiable decision can be reached.

Primary among these factors is consideration of the firm's existing facilities. Where the bulk of a company's production is of a certain type, a considerable investment has been made in specialized plant and equipment; a skilled work force has been assembled and trained; and a certain familiarity with both the product and its manufacture has been attained.

If a component part is adaptable to this type of manufacture and can be readily made at low cost in a form that is equal or better than could be obtained elsewhere, it is more than likely that the firm will fabricate the part. This is only common sense, since the company's investment must be utilized to its fullest possible capacity to earn a sufficient return. If, on the other hand, factors such as quantity of part required, available manufacturing space, equipment, personnel, material supply, costs, etc., are unfavorable or if present production schedules are so crowded as to preclude increased operations, then it is quite possible that the part will be purchased from an outside source.

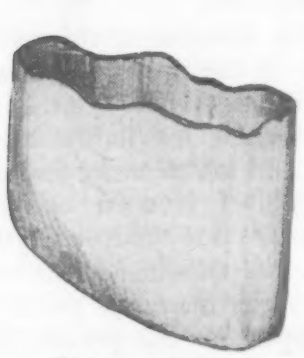
The design of a product often presents a choice in the selection of material from which it is to be made. This material choice, in turn, often has a bearing on whether the part should be bought or made. The following discussion is an example of this. Here, the question arose concerning the thumb-piece for a cabinet handle such as is used in modern kitchens. The thumb-piece was required to be movable (to operate the latch mechanism) and to have a pleasing appearance and a high finish. The thumb-piece was to fit into the metal handle as shown in photograph.

Three possible materials were considered for this item: a metal stamping, a plastic molding, and a die casting. Since the firm manufacturing this item was predominantly a metal-working shop and had no facilities for molding plastics or producing die castings, the choice resolved into making the part as a metal-pressing or buying it outside in either plastic or die cast form.

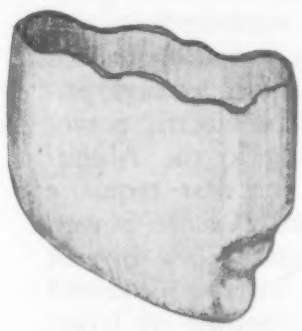
With the assumption that all three could be produced so as to be suitable in strength and appearance, the all-important factor in this case was over-all cost. It was known, at the outset, that the stamping and die casting would require both finishing

Metal Stamping	
Material (Brass)	$15.00
Blank and Draw	4.30
2nd Draw	7.00
3rd Draw	7.00
Trim Top	7.00
4th Draw	7.00
5th Draw	7.00
Flatten Lug	6.00
Insert	
Material (Steel)	3.00
Form and Blank Complete	2.80
Weld Insert to Shell	12.00
Finishing	
Cut Down	20.00
Degrease	1.00
Color	12.00
Plating	12.00
Total:	$123.10
Die Casting	
Material (Raw Die Casting) —from Vendor	$45.00
Finishing	
Polish Flash	16.00
Buffing	32.00
Plating	12.00
Total:	$105.00
Plastic	
Material (Complete Plastic) —from Vendor	$22.40
No Finishing Required	—
Total:	$22.40

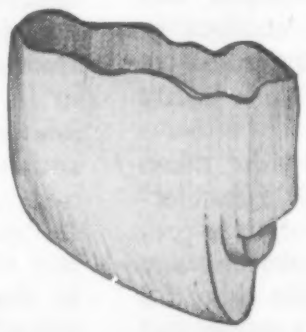
Successive steps required in the fabrication of movable thumb-piece for cabinet handle by metal-pressing technique. Such thumb-pieces



blank and draw



2nd draw



3rd draw

trim

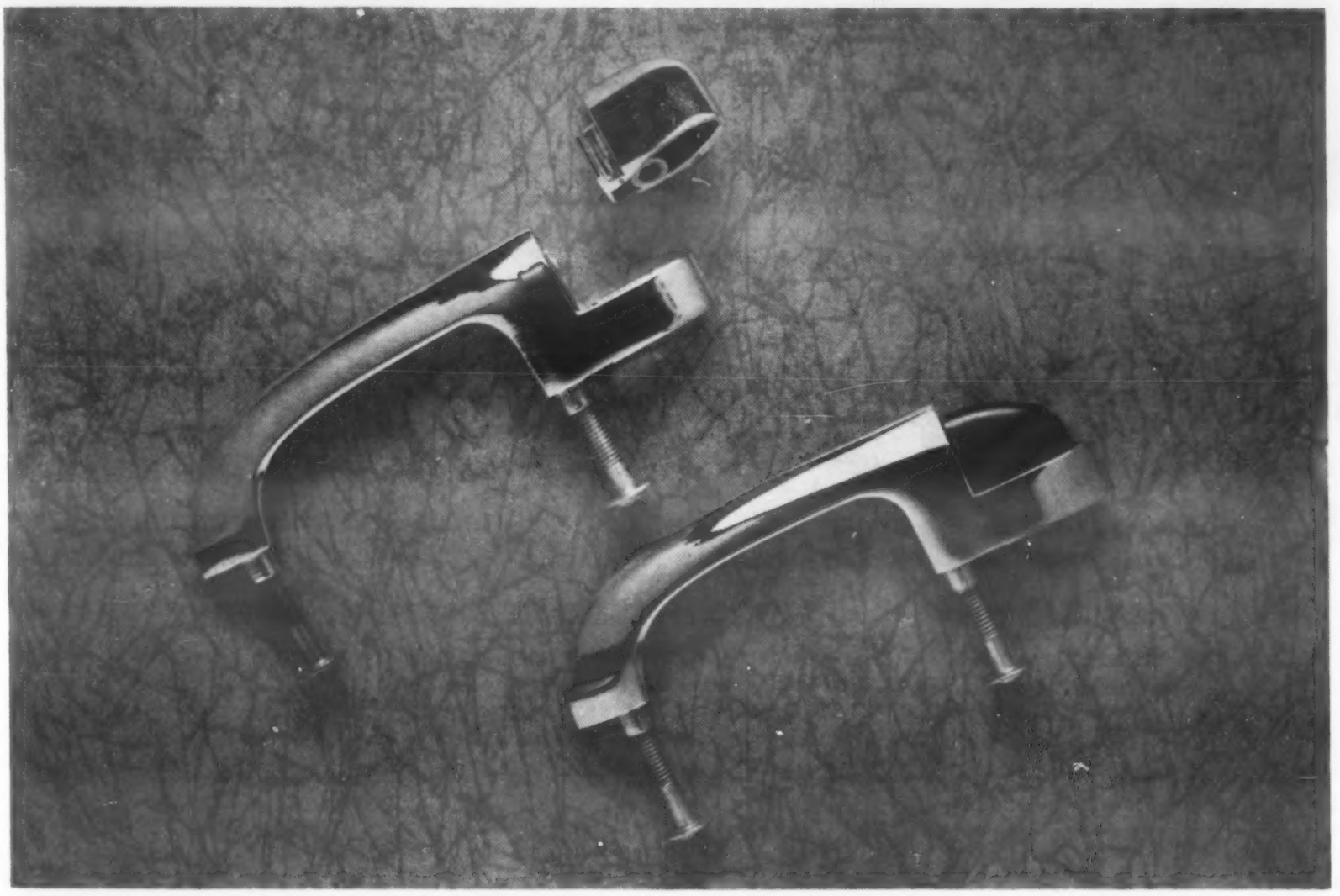
and plating, whereas the plastic part could be used as received from the vendor. In addition, the stamping, as shown in drawing, would require a welded insert for purposes of operating the latch, while both the die casting and the plastic would have this section as an integral part of the finished piece. Since a large production run was anticipated, the following cost analysis for a given quantity was set up for each of the proposed methods. From this, the most satisfactory solution was obtained.

It should be noted that the company makes it a practice to include a reasonable overhead or burden in the labor cost on all operations performed in its own plant. This company-overhead is not included in the cost figures of the purchased part, although it might be argued that at least some portion of administrative overhead, cost of buying, etc., could be legitimately attached thereto.

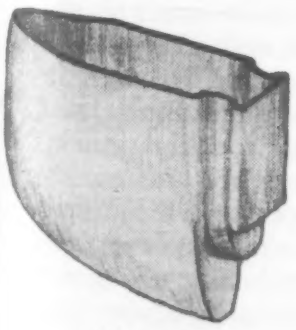
As can be readily seen from these figures, the plastic showed an overwhelming cost advantage, and was selected on the basis of this analysis. When it was later decided to use a metal, as well as a plastic thumb-piece, the die casting was selected over the stamping on the basis of the same analysis, even though, here too, it meant buying the part instead of making it in this company's plant.

This is the type of analysis that must be made before an intelligent answer to the question of making or buying parts can be determined. Rules-of-thumb, snap judgments, and the like will inevitably lead to financial loss, since there is no set formula that governs all cases and the answer doesn't always come out the same. In addition, the performance of product components is usually improved through the use of the best possible material and fabrication technique, irrespective of their source. Established procedures should not be blindly followed merely by virtue of custom or existing equipment. Instead, cold reasoning, backed by current cost figures, should determine the choice for ultimate product success.

Cabinet handle with movable thumb-piece such as is used in modern kitchens. Plastic thumb-piece installed in handle (right) was found to be cheaper than die-cast and plated thumb-piece (left) on basis of cost analysis. Both types, purchased from outside suppliers, were cheaper than those metal-pressed in the company's shops.



made in the company's shops, were found to be much more expensive than either plastic or die cast types, which could be purchased from outside suppliers.



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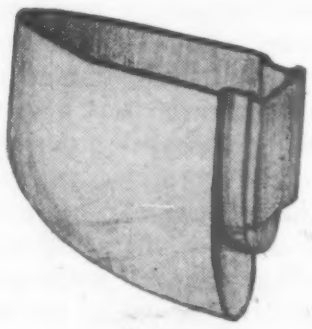

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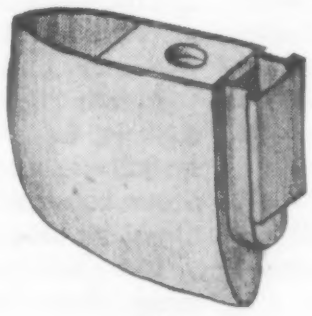

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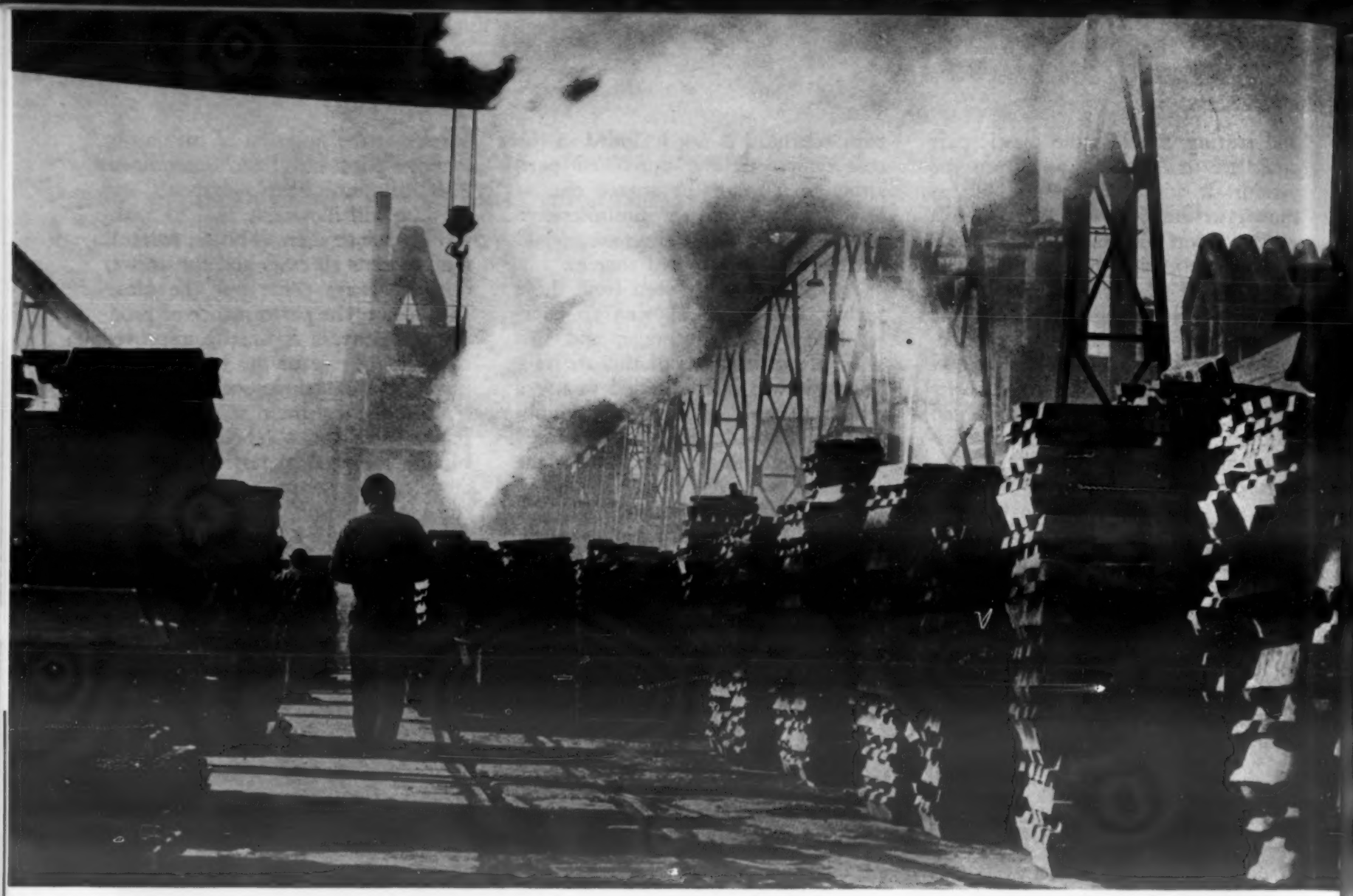


For many years secondary lead has been one of the prime sources of that important metal. (Photo: Courtesy American Smelting & Refining Co.)

Secondary Metals Now Accepted as of High Quality

With proper care in melting and refining scrap metals, there is little reason, except for some antedated specification, to keep secondary metals from any normal application.

by **KENNETH ROSE**, Western Editor, Materials & Methods

● FOR MANY METALS such properties as forgeability, ductility, electrical conductivity and corrosion resistance are greatly affected by the presence of even small quantities of alloying elements or nonmetallic inclusions. Metals produced from melted-down scrap with little in the way of refining are ordinarily higher in content of such elements than carefully refined virgin metal, and may show inferior properties. From this there developed the idea that primary or virgin metals were superior materials, and that secondary metals were necessarily inferior in properties.

The stigma attached to secondary metals was reflected in the demands by purchasers that, for applications requiring maximum properties in certain categories, no secondary metal was to be supplied. Government specifications sometimes required primary metal. All in all, "scrap" metal was under a cloud.

It must be pointed out, however, that the term "scrap metal" includes several types of material that were never regarded as low-grade. Scrap might be broadly classified as:

(1) *Mill scrap*—including trimmings from ingots and billets, returned to a melt of the same composition, usually inside the mill of the metal producer.

(2) *Segregated scrap*—with which may be included punchings, chips, and surplus metal, carefully segregated by the manufacturer in his plant as he uses the metal, and returned to the metal producer.

(3) *Country scrap*—consisting of unsegregated or very roughly sorted scrap from scrap dealers.

Use of mill scrap, for which the composition is exactly known, in melting-down for production of ingot at the mill of the metal producer is

general practice. Such metal is sold as "virgin metal." The whole procedure amounts to no more than a recirculation of the metal.

By a slight extension the same procedure is made to cover the remelting of segregated scrap returned to the metal producer by a manufacturer. In this case also the exact composition of the scrap is known, and it is returned and melted down with another batch of the same metal.

Somewhat more elastic use of the term "primary metal" is needed to cover another practice sometimes followed by metal producers. In this case a quantity of country scrap is added to the crude metal won from the ore, and the two are refined together. The fact that the product is sold as virgin metal demonstrates the inaccuracy of the term when used to designate metal won from ore exclusively.

During the past 15 years a change has occurred in industry's views about secondary metals. Some of the factors influencing this change were:

1—Results in some industries, such as the automotive industry, showed that secondary metals could possess acceptable properties for even severe service requirements, and would sometimes show advantages. For example, aluminum engine castings of secondary metal were found to have better grain structure than those of primary metal.

2—Improved refining and smelting techniques, or at least more careful attention to these techniques, made possible the production of secondary metals with lower content of impurities.

3—Wartime shortages made use of secondary metals necessary for many purposes, and the replacement was found to give satisfaction.

4—During and immediately after the war the country became conservation-conscious. This was manifested in two ways, (a) by an awakening to the country's dwindling natural resources, and (b) in an attempt to change wasteful practices in the collection of scrap in manufacturing plants. The effect of both was to cause industry to consider secondary metals more favorably.

At present, it is standard practice to buy metals to composition or performance specifications, without regard to whether the metal is made from scrap or virgin ingot. Some government orders still specify virgin metal for a few purposes, but these are exceptional. The A.S.T.M. specifications are set up upon a basis of composition or performance.

In line with this present-day attitude, there is a growing recognition of the importance of segregating scrap in the manufacturing industries, and of returning it free of contamination to the metal producer when such agreement exists, or of selling it at a premium as segregated scrap otherwise. This practice received an impetus during the war, when metal producers were in a position to demand that scrap from many of the higher-priced alloys be segregated and returned to them as a condition for filling orders.

Another fact of importance to both the metal producers and the metal users is the more flexible price situation of the secondary metals. In times of business depression secondary metals move in the market more readily than primary metals, because the miner and ore smelter have relatively rigid costs, whereas the secondary smelter can control the price of scrap to a considerable extent.

Tabular data are taken from the American Yearbook of Metal Statistics for 1947. Figures are difficult to interpret as applied to the past few years, as the effects of government stockpiling in the case of some strategic metals, and release of government stocks in the case of others, are sometimes impossible to evaluate. Another factor is the tremendous demand for most metals, and especially steel, bringing with it prices for scrap that sometimes rise above the price of the semi-finished metal. The result is a completely unsettled state of affairs in which it is impossible to distinguish any trend, except in the very broad acceptance of secondary metals by industry. From this, and the fact that these secondary metals are meeting requirements, combined with mineral reserves already seriously depleted for iron, aluminum and copper, it may be surmised that secondary metals will hold an increasingly important place in our industrial economy in the future.

Steel

There is no "primary-vs.-secondary" problem in the case of steel. Steelmaking has become so well established in its methods that production of a grade of metal suitable for all purposes can start with 100% scrap, 100% pig, or just about any mixture of these materials. Unwanted elements are eliminated by oxidation or in the slag, and the steel can be produced to any specification.

It is a matter of record that steel is produced from about 75% scrap in ordinary circumstances. The percentage of scrap used is influenced by economic conditions and by supply and demand rather than by any thought of inferiority or superiority of the end product. Most steel scrap is purer than pig iron anyway.

An interesting sidelight upon the question of use of scrap in production of steel developed during the war, when it was found that the nickel content of plain steels had increased a few tenths of 1%. As no nickel had been added to the steel in the immediate processing of the material, it was evident that the trifling nickel content had gradually accumulated during many cycles of use and remelting. The slight increase in this nickel represented alloying metal lost through lack of segregation of scrap.

Aluminum

The aluminum industry presents a picture illustrating the change in thinking about secondary metals. For many years it was assumed that aluminum for the high-grade forging alloys must be primary metal, and not without reason. Good forgeability and good corrosion resistance are closely associated with closely controlled composition, and several alloys are supplied in special grades, with iron and nickel content held to very low limits. Removal of all alloying elements from aluminum scrap by the smelters is impractical under ordinary conditions, but by careful scrap segregation, and sometimes by addition of pure aluminum to the melt of scrap,

Some experts claim that for many uses aluminum refined from scrap is better than virgin metal.

Aluminum scrap accounted for about 61% of the 1947 production of that metal.

satisfactory commercial alloys are produced. These are usually the alloys for sand- or permanent-mold casting, but properly segregated scrap can be used for the forging alloys also, usually of the same composition as the scrap.

The usual smelting processes for scrap do not remove copper and silicon. A process new to this country, but used with considerable success by one of the large aluminum producers, is the continuous gas fluxing method of aluminum refining, developed in Germany during the war, and brought to this country by American industrial investigators. It involves bubbling gaseous chlorine continuously through the scrap melt. The chlorine is especially effective in removing magnesium. Thousands of tons of aluminum ingot have been produced by this method and rolled into sheet for structural use, even when the scrap has been such mixed material as battlefield scrap.

In spite of the necessity for close control of composition in the high-strength alloys, aluminum producers and smelters of secondary aluminum have always found it possible to use large quantities of aluminum scrap. As has been pointed out, segregated scrap can go into the forging alloys, and millions of pounds of 14S, 17S, 24S, and other standard compositions were produced by secondary smelters during the war. The low-strength casting alloys have always taken much of the badly mixed scrap. Secondary alloys have been preferred in the case of material for engine castings for the automotive industry, especially for cylinder heads and crank cases, because of better grain size. Aluminum badly contaminated with iron can still be used for deoxidation of steel, or for production of thermit powders.

The effect of economics upon the amount of secondary metals used is shown in the case of aluminum as well as in other metals with more flexible specifications. The ratio of secondary to primary in prewar years has varied widely, but secondary has usually been substantially less tonnage-wise than the production of virgin metal. In 1934, however, the tonnage of secondary was about 136% of that of primary.

For 1947, aluminum production reached 1,143,000,000 lb. About 750,000,000 lb. of scrap was used, and this may be considered as equivalent to 700,000,000 lb. of secondary ingot, or of secondary aluminum blended into virgin metal. This would mean that aluminum scrap accounted for about 61% of the 1947 production of the light metal.

Secondary aluminum, then, is usually produced as casting alloys, sand- or permanent-mold, but can be returned to industry in the form of forging alloys if scrap is carefully segregated and the proper refining techniques are used.

Copper

Copper presents a picture of well established metal technology and fields of use. The output of the metal is taken by:

- Electrical wire and cable, about one-half
- Cuprous alloys, about one-fourth
- Fabricated electrical items, pipe, automotive parts, about one-fourth

Because of conductivity requirements, electrical wire is made from specially purified virgin copper whenever possible. Electrolytic refining, in which the copper is electrodeposited from a solution with the unrefined or fire-refined metal as anode, is the means of purification. Secondary copper of good purity could be used as anode, and in times of stress may be so used. Normally, however, secondary copper goes into the second and third groups of applications, especially the former.

Brass castings and some wrought brass have always taken large amounts of secondary copper or "composition ingot" for their manufacture. Scrap brass in which zinc and tin are retained forms the basis for composition ingot, and secondary copper is usually scrap conductivity copper, which is of high purity. During the war it was found feasible to "downgrade" brasses and bronzes for many applications, such downgrading consisting of substitution of alloys lower in tin content or made with secondary copper or alloy. The recent skyrocketing price of virgin copper, representing increased cost of obtaining the metal from domestic mines, makes it likely that this downgrading will carry over into civilian production even when actual material shortages no longer exist.

While some of the wrought brasses can use secondary copper, deep drawing brasses are almost exclusively made from primary metal. Even small quantities of impurities affect the drawing qualities adversely, so that such brasses as cartridge brass usually take virgin copper.

The crude production of primary and secondary copper in the United States in recent years has been as follows:

	Primary	Secondary
1935	393,614 short tons	112,471 short tons
1936	630,557	101,072
1937	868,003	114,042
1938	578,772	66,097
1939	744,190	91,884
1940	915,217	77,076
1941	985,288	31,708
1942	1,098,007	54,337
1943	1,111,022	83,677
1944	995,938	60,242
1945	792,126	49,541
1946	618,757	32,503
1947	871,391	105,307

These figures do not represent supply or demand accurately, due to release of metal from stockpiles and to importations, but they do convey a general picture of the primary-secondary situation. During 1947, with a total of 976,698 tons of primary and secondary copper in the country's crude production, 1,383,666 tons were delivered to domestic fabricators, indicating that 406,968 tons of copper, primary and secondary, came from stockpiles and from foreign sources.

Zinc

The most important use for zinc in

	From Foreign and Domestic Ores	Secondary, Distilled	Grand Total, Slab Zinc (Short Tons)
1936	492,132	42,209	534,341
1937	556,904	51,554	608,458
1938	446,341	31,613	477,954
1939	507,236	50,428	557,664
1940	675,275	48,917	724,192
1941	822,020	59,503	881,523
1942	891,872	53,195	945,067
1943	942,309	48,215	990,524
1944	869,302	49,037	918,339
1945	764,561	49,242	813,803
1946	728,262	44,516	772,778
1947 (Prelim.)	806,100	56,100	862,200

terms of tonnage is in the galvanizing of iron and steel. It follows that this protective metal is not recoverable as scrap, so that a large part of the annual production of zinc disappears from the metal market permanently. The second largest use is in production of die castings, and scrap die castings appear in the market as a source of secondary zinc. Next in volume of zinc used is the brass-making industry. Here the zinc is not recovered as zinc metal, but is returned to industry as an alloy, usually to be used for making other brasses.

Because the die casting alloys must be closely controlled as to composition, scrap zinc is not considered a suitable ingredient, and even scrap die castings are not used. Secondary zinc may be distilled from drosses or other residues, or, if for alloying with other metals, may be melted down from scraps of sheet zinc, old battery plates, scrap die castings, etc. The redistilled zinc is of high purity, and may be used for most purposes for which primary zinc would be suitable. Scrap sheet zinc produces a grade of secondary suitable for alloying in brasses, etc., while the scrap die castings may go into production of zinc dust or zinc oxide.

Some recent figures upon zinc production are shown above.

Lead

The position that scrap has held in the lead industry is summed up authoritatively by Robert L. Ziegfeld of the Lead Industries Association, who writes, "Over a period of years scrap has supplied an average of about 36% of the total lead consumed, but in 1947 this percentage was somewhat higher." The secondary lead so produced is largely in the form of a lead-rich alloy, which simplifies the refining and also recaptures other metals, principally antimony and tin. The secondary antimonial lead is an important material in the manufacture of storage battery plates, and lead-tin alloys find use in production of soft solders, bearing metals, etc.

The following products take the output of lead in the amounts indicated:

Storage batteries,	about 30%
Cable coverings,	about 13%
Lead pigments,	about 10%
Building uses,	about 7%
Solders,	about 5%
Bearing metals, type metal, tetraethyl lead, etc.,	smaller amounts

Production of lead from ore has been at a rather stable figure in the United States, with imports of ore, or metal as pigs or bullion, expanding to meet increased needs. Production of lead from ore is given below.

It is worth noting that most smelters of primary lead handle a certain amount of scrap also.

Nickel

A small amount of nickel-rich alloys come into the market to provide some secondary nickel. These find use in such nickel-bearing compositions as nickel silver, nickel brasses, cast Monel metal, etc. Secondary nickel recovered from anodes for electroplating and from sheet nickel may be used in producing the nickel-bearing ferrous alloys. When proper scrap segregation is practiced, the nickel content of nickel-bearing cast irons and steels can be recovered also, utilizing this scrap in the production of suitable ferrous alloys of the same or similar composition. A widely used form for the secondary nickel-copper ingot is a 50-50 composition sold in pigs for alloying.

In the case of magnesium, all ingot as supplied for magnesium alloys is strictly virgin metal. Much magnesium goes into chemical processes and into other applications, such as deoxidizing, where it is consumed, and this is removed from the metal market. Secondary magnesium is not an article of commerce, but because definite impurity limits have been set, for the standard alloys, and all virgin ingot is well below these limits, it is possible that scrap metal might be used in some compositions if limits are carefully controlled.

Among the minor metals, the story of secondary tin is a classic example of the possibilities of recovery methods, and of the effect of economics. Ordinarily, tin is recovered in bearing metals and solders, and in high-grade bronzes, the product being an alloy containing the valuable metal, and suitable for return in manufacture of a similar composition. When, at the outbreak of the war, the need for tin overrode economic factors, elaborate wet chemical methods were developed to reclaim the tin coating from scrap tinplate. These would have been uneconomical in normal times for the recovery of even such a relatively high-priced metal as tin. When necessary, however, it was possible to obtain pure tin from this unlikely source.

This is the story of the purity possible in secondary metals. It is always possible to purify scrap metals to any degree desired, but costs for many of these processes would be fantastically high. Instead, secondary metals become important materials when simple purification methods will yield a metal or alloy of such composition that it satisfactorily meets certain industrial needs, and can be sold at a price competitive with primary metals. Use of secondary is no longer a matter of accepting a less pure metal because it is cheaper.

	Lead from Ore in U.S.	Imports of Ore (Calculated to Metal) Pigs, Bullion
1939	413,979	85,132
1940	457,392	282,472
1941	461,426	381,008
1942	496,239	489,714
1943	453,313	318,639
1944	416,861	316,386
1945	390,831	297,482
1946	335,475	156,772
1947 (Prelim.)	375,267	211,853

Materials Shortages and Rising Labor Costs

by HERBERT CHASE

Alternate fabrication methods currently receive attention in effort to reduce production costs and conserve materials supply. Casting, sintering and mechanical forming supplant expensive machining in drive on expense and waste.

● WHEN LABOR costs are high and materials are scarce, there is more need than ever for engineers to keep abreast of processing procedures and alternatives in material selection if production and marketing requirements are to be met. Indicative of this is the forming vs. machining trend. As machining costs continue to rise, more and more designers and production men are turning to alternate methods of product fabrication in an attempt to reduce or eliminate the amount of machining formerly required. And, although the well-tried, basic methods may continue indefinitely, they are constantly undergoing detailed improvement, some of which may spell the difference between meeting competition and falling behind in the race.

Considered here is a review of current practice in three major forming categories: (1) casting; (2) sintering powdered metal compacts; and (3) mechanical forming from wrought metals available in such forms as sheet, bars, tubes, or similar stock. These methods are being utilized to an ever-increasing extent to sidestep excessive production costs. Specific examples are included to show what has been accomplished in particular instances. A study of these is instructive because it is easy to learn from what others have actually accomplished and because, even if the example does not apply to a particular set of conditions that the reader faces, it may suggest a good way of meeting similar problems.

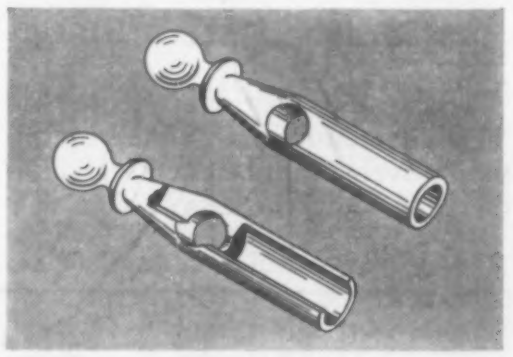
No attempt is made to formulate categorical rules of procedure. Each set of conditions requires a careful study of alternative procedures, perhaps involving the use of different materials. Not until the alternatives are weighed from different angles and cost estimates are secured will the optimum choice become apparent.

Umbrella rib tips here shown are now produced in million lots at the rate of 100 a min. in zinc alloy on an extra fast die casting machine, both holes being cored. Prior production on a screw machine required cross drilling, was much slower, and cost per part was higher.

Casting

Casting yields advantages that are well known. But, in common with other processes, it imposes certain limitations. Primary conditions are the cost of the mold or molds required of the pattern or patterns; of the metal to be used; of the labor and equipment needed; and of the amount of machining essential to yield the desired dimension and finish.

Recent years have seen marked advances in die casting, permanent mold casting, and precision or investment mold casting; yet sand casting continues to hold a paramount place, partly because of improved facilities for making molds and cores, and because time per mold has been greatly decreased. Many castings, including all those of large size, can be produced today only in sand molds.



Die casting is still confined to relatively few nonferrous alloys, over 90% of the tonnage still being in zinc base and aluminum base types. The latter base has gained over zinc, especially in castings that weigh 2 to 3 lb. or more and that are to be made

Force Changes in Manufacturing Techniques

in new dies. This is because the metal cost per casting has been lower for aluminum. In smaller die castings, where metal cost per casting is a less important consideration, zinc retains its predominance, because casting is easier and more rapid and plated finishes cost less on zinc than on aluminum.

High-purity zinc for die casting continues high in price and in short supply, but a large proportion still goes into hardware and automotive use, where demands for fine plating are exacting.

One die caster, normally using only alloys based on aluminum and on magnesium, is now marketing magnesium alloy castings at a lower cost per casting than for aluminum or for zinc. He reports a higher casting rate for magnesium than for aluminum, and metal cost per casting is significantly lower. Machining, too, costs less in some cases. But all magnesium castings require pickling and an applied finish, whereas aluminum and zinc castings are often used without any applied finish.

All die castings can be produced very close to size, with most holes cored and surfaces about as smooth as the die surfaces that form them. Savings in machine work are commonly very large and soon offset die costs. In addition, sections generally can be much thinner than for sand casting and the chill produced by the die has a beneficial effect on properties. Casting rates are high and are being considerably increased in some cases by the use of faster machines.

Another great advantage of die casting is the ability to make several parts, all duplicates or all different in a single die filling. The lock industry is among those using this expedient to marked advantage.

Permanent mold casting, although it has expanded, has not registered the gains recorded in some other types of casting. A dominant proportion of the output continues in aluminum alloys, but some producers do work in alloys based on magnesium, copper, zinc and lead. Excellent castings are produced but dimensions are not held so closely as in die casting, the minimum feasible sections are thicker, and surface generally not so smooth.

It is possible, however, to produce gray iron castings in permanent molds, whereas they are not producible by die casting. Few foundries are equipped for such gray iron permanent mold casting, and the castings produced are small in size. Many nonferrous castings made in permanent molds have sand cores that can produce under cuts of types not possible in die casting. Much larger castings are also feasible, especially in aluminum and in magnesium.

Some substantial advances have been made in precision investment casting. Most noteworthy of these is the near elimination of skilled hand work in one of the most advanced processes. In this, patterns are made from a special styrene plastic on a semi-automatic basis and assembled into "trees" by the press operator, after which the trees are invested without applying a special coating.

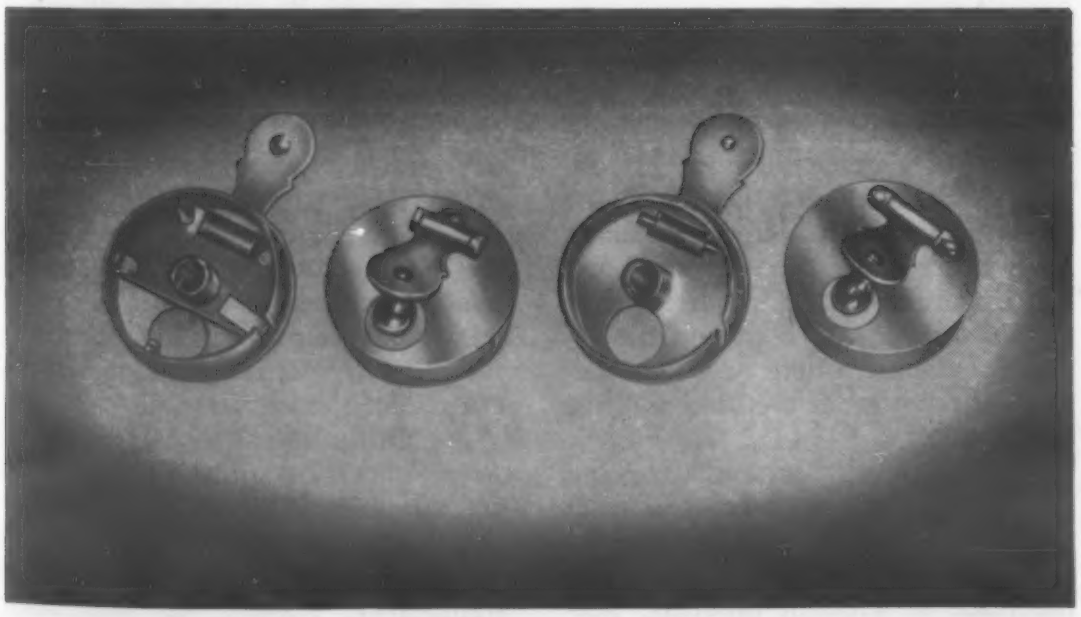
Flasks used in this process are filled from a hose after the slurry components have been weighed out and mixed in automatic equipment. After being put through a vacuum tank and baked, to remove moisture, molds are fired. During firing the plastic melts and runs out, leaving the mold cavities empty. When casting is done centrifugally, no risers are required and the yield of sound castings is high. Practically no highly-skilled labor is necessary, and the total labor required is reduced to a small fraction of that needed for equal output in the ordinary precision casting setups.

To date, ferrous alloys, including stainless and tool steels, have been most widely used in investment casting, but many nonferrous alloys can be used equally well when specified. The chief disadvantage, that of high labor costs in preparing patterns and molds, has now been greatly reduced.

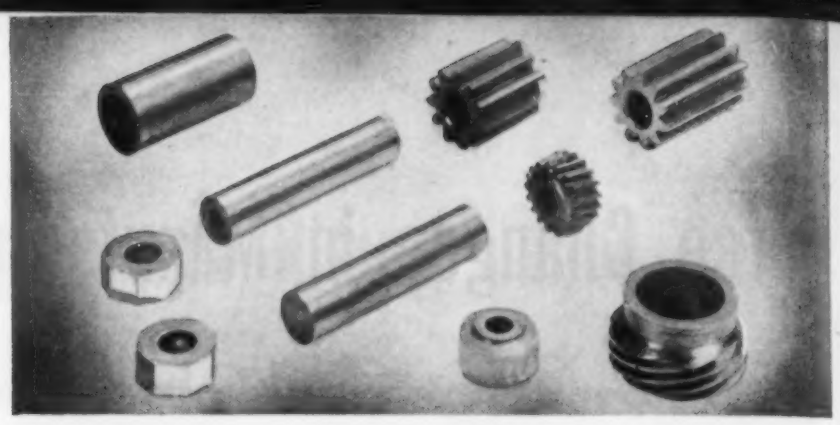
Advantages of investment casting include ability to cast complex shapes and relatively thin sections. Dimensions can be held very close to size and good surface finish is attained. Dimensional accuracy and finish are not quite as good as for most die casting but are so good that little if any more machining is needed. In general, several castings are made per mold, but the number of molds filled per day is far below that for die casting.

On the other hand, most of the alloys used cannot be die cast or cast in permanent molds. Precision far exceeds that for sand casting, and surfaces are much smoother. When

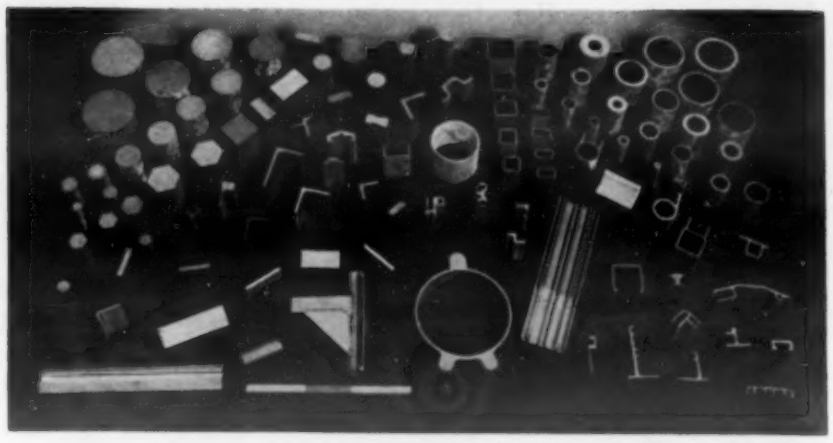
Stampings formerly were used for the winding spool and cover for a steel tape unit, as shown at left, but costs were decreased about 75% by substituting the zinc die cast elements, right. Strength and appearance also were improved and less manufacturing space was needed.



This sintered brass powder compact constituting a lock body has displaced a nearly identical sand casting. Machining operations are cut from 26 to fourteen, rejects greatly reduced, cost lowered and dimensions held within closer limits. Inclusions are absent and tool breakage is decreased.



All of these parts for 1949 Ford passenger cars are produced from sintered powder compacts. Very little machine work other than coining is required but, in the case of the helical gears, the teeth are cut in the sintered blank.



Variety of special cross-sections obtained by extruding and rolling operations. These have found many new fields of application but commonly require one or more machining operations.

any machining is needed, only very light cuts are commonly necessary. To date, most precision castings have been of small size, but castings up to 30 lb. or more in weight can be made if flasks of adequate size are provided. In the past, the cost of the molds and patterns has been high, but it is lowered greatly in the latest installations.

This, briefly, is the situation as it applies to current casting practice. Many products formerly machined from stock are now cast successfully and very close to finish size. Savings in machine work often are very great, and physical properties equal to or exceeding those of machined metals commonly are attained even though grain structure is not the same.

Parts produced from metal powders (sometimes with a low content of nonmetallic ingredients, such as graphite) may be considered roughly as intermediate between cast and wrought products, although they have some properties not found in either wrought or cast metals, and composition in some cases cannot be duplicated in any other product.

In all instances, powders are first mixed and then are compressed in dies to form green compacts. The compacts are sintered, generally in a controlled-atmosphere furnace. Thereafter, the resultant product is often coined, making it somewhat denser, improving surface finish and holding dimensions within quite close limits.

All sintered metal compacts are porous and are generally inferior in strength to wrought metals. But frequently they duplicate or surpass those found in cast metal of similar composition. Porosity is an advantage, however, in many cases, as the compact absorbs oil useful in lubrication and sometimes permits the part to be used as a filter or diffuser. Unusual magnetic properties are possessed by some compacts.

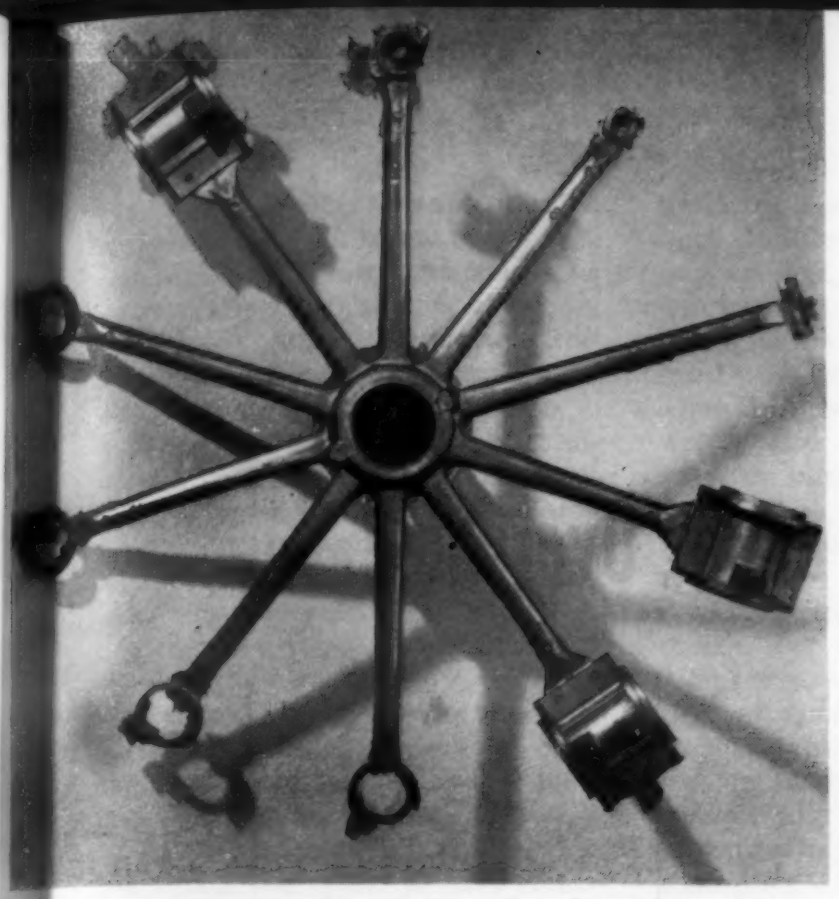
Many compacts are made in shapes that save a great deal of machine work, and certain dimensions are often held (especially after coining) as close as can be held by any save the closest machine work. There are, of course, some limitations on the shapes that can be produced as well as on maximum feasible size. But, in some cases, cost per piece is well below that for any part similarly shaped and held within equally close dimensional limits.

Compacting and coining are very rapid operations and sometimes are done on automatic machines that need little attention. Sintering is slower but generally is done in continuous furnaces that need only be loaded and unloaded. In consequence, labor charges per piece are low and little manual skill is required. Die costs, however, are high and die replacements are often needed, especially if the powder used has abrasive properties.

Under these circumstances, it is not surprising that the sintered compact sometimes has replaced castings and, perhaps more frequently, has taken the place of wrought products. Material cost is likely to exceed that for either a casting or for a wrought product, but it often happens that savings in machine work much more than offset higher material cost besides amortizing die costs. In general, there are ample supplies of powder available, hence the substitution of a part made from powder for a wrought or cast product releases that much metal for other uses.

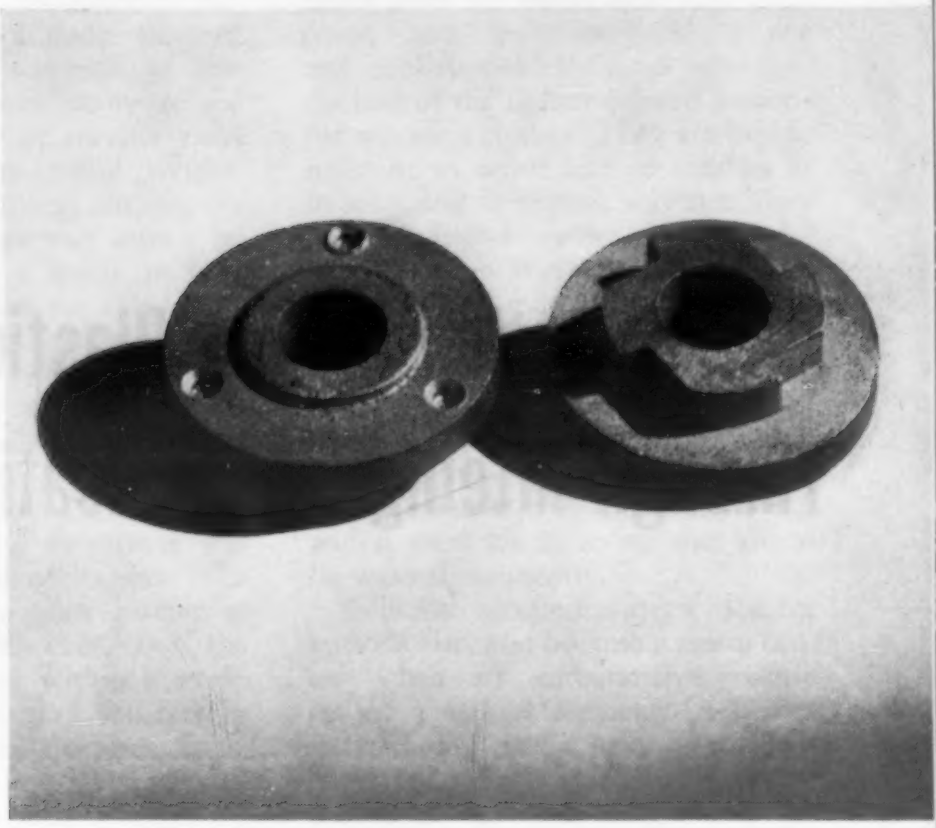
Basic wrought products, such as sheets, bars, tubes, extrusions and rolled shapes, generally cost more per pound than ingots for casting but less than powdered metals. If much waste occurs as a result of machining, the cost of the finished piece goes up. Total cost per piece is affected by many factors, of which machining is often the greatest. For the casting, machining cost may be either high or low, depending upon the type of casting used, the number and length of operations, and the amount of metal removed. The same may be true of the wrought part, but there are many cases in which the cost of metal machined away equals or exceeds that remaining in the piece. Forging and some other operations can reduce the loss in some instances.

Methods of converting basic wrought products into finished parts are too numerous to be dealt with extensively here, but some remarks in this regard may not be without significance. Forging has long been



Gate of ten zinc die castings for a Yale tubular lock, all produced in a single die filling and with marked economy. Such castings commonly require little or no machining except to shear off flash.

A cost reduction of 84% resulted when this record changer part was converted to a sintered powder compact containing 5 brass, 5 copper and 90% iron. Formerly, wrought components were made separately and staked at assembly. Close dimensional limits are held.



used not only to save metal and reduce machining costs but also to improve grain structure. Forging cost, however, is not inconsiderable.

Among the methods employed to reduce forging cost are the use of induction and radiant heating and the use of presses in place of forging hammers. Press forgings have an advantage in that little skill is required; hammer forgings require experienced and extensive labor. Induction, radiant and controlled-atmosphere heating help to reduce or eliminate scaling. This not only reduces waste but also helps to increase the life of forging dies.

Forging die costs have been halved in at least one plant by the use of deflocculated graphite as an initial lubricant and by careful control of forging procedures. In this plant, increase in billet size with die wear has become unnecessary and flash thickness is minimized, both of which help to reduce steel consumption. Where forgings are held close to finish size, scrap losses are lowered and less stock has to be removed in machining operations.

Stamping continues in extensive use, partly because it is one of the fastest production processes and yields extremely useful products at low cost. Increasing use is being made of nearly all sheet metal economically adaptable to stamping operations, with aluminum so much in demand that some grades are now scarcer than steel, despite new sources of supply and increased output from older sources. In fact, sheet metal of all kinds, except perhaps magnesium, is in short supply. Stainless steel sheet is in wide use for many high grade products, and its utility has been increased by the availability of shielded arc welding.

Steel shortages have made it necessary to use sheet as thin as will meet requirements, and this has often multiplied production problems; especially where, as is often the case, the steel is not that best suited for severe working. Where possible the depth of draws has been decreased and severe working has been avoided or made easier by local or other annealing, some of it done by induction heating.

Parts that fracture in severe working are often repaired, and some that can be drawn in one piece when optimum drawing grades of sheet can be had are made now in two or more pieces and welded. In some cases, this decreases rework and also makes it possible to use less steel because smaller sheets are used and less stock is left for trimming. Some reports show much lower scrap loss when hydraulic presses are used because the drawing speed and pad pressure can be adjusted to meet the special conditions imposed.

Screw machine products, another major high-production item, are as popular as ever, but efforts to cut scrap losses are made so that the bar stock used will go farther. There is often competition between the screw machine and the cold header, the latter having an advantage in some cases because its use involves little or no scrap.

Current shortages of tubes have restricted their use in some products. Welded tubes and pipe are extensively produced, of course, but demand continues to run far ahead of supply. Welding of tubes having walls up to at least 4 in. thick is now possible with welds that are as strong as the tubes themselves.

Extrusions, including the comparatively new types produced in alloys based on zinc and magnesium, have found some new fields of application but commonly require one or more machining operations to adapt them to end uses. Some brass forgings are made from extruded shapes because such slugs are nearer to the shapes required than slugs cut from bar stock. Thus, less flow of metal in the forging die is required. Some cast billets, especially for large aluminum forgings, have been used in place of billets cut from rolled or extruded bar. This has been done chiefly because wrought billets of required size could be had where extruded or rolled billets were not available.

Such are a few of the alternative production techniques that are currently in use to reduce excessive machining costs. Use of these has often necessitated a redesign of the product in order that the advantages of lower materials costs and lower fabricating costs might be achieved. In such cases, however, the redesign has usually resulted in a better product, and this fact alone is but added justification for the change in manufacturing technique.

Misconceptions About Plastics Being Overcome Through Intelligent Application

Since plastics have been deglamorized, they are being used in applications where they fit—a blessing to producer and user alike.

by **KENNETH ROSE,** Western Editor, Materials & Methods

● THE PLASTICS INDUSTRY has been given a difficult assignment by the American public. During the war years Sunday supplement feature writers, song spinners, and airbrush engineers have been telling the people of the brave new world just around the corner, when practically everything would be made of these new wonder materials, plastics — a whole houseful of technicolor soap bubbles, with the house itself "a little plastics palace." People were conditioned to readiness for the pile of plastics household gadgets that appeared on dime store counters, and they bought liberally—for awhile. Unfortunately for the plastics industry, many of these gadgets were made of materials entirely unsuited for the service conditions under which they were required to perform. Their failure left a decidedly bad taste in the mouths of a large part of the American mass market. Because the word "plastics" had been used so generally for all of the large and diverse groups of materials, this unfavorable reaction was felt throughout the industry. Most severe in the field of small molded consumer items, even industrial goods came under the cloud to such an extent that a manufacturer of office equipment at one time advertised that his articles contained no plastics.

About a year ago the custom molders of thermoplastics were deploring business conditions and the business outlook. Today most of them are again reporting good business, reflecting the reappearance of plastics items in the small consumer goods class. The American public still expects the plastics industry to make good upon the predictions of enthusiastic but technically illiterate forecasters.

Within the industry there is considerably less forecasting as to the possibilities of plastics and more careful study of properties. There is also the realization that, with the present "pigs is pigs" attitude toward plastics by the public, any misapplication of plastics reflects upon the entire industry. The leaders are stressing the importance of careful selection of the proper plastics material to meet the specific needs of the job for which it is intended.

Misapplications of plastics have been of three general types:

(1) During the war, and the period of shortages of many types of materials immediately following, substitutions were sometimes made. In some cases the plastics material substituted for a satisfactory type was inferior, but was used because it was the best thing available. There have been several other cases of substitution of an inferior material for a superior in which cheapening was the purpose.

(2) Probably the largest group of misapplications have been that in which a lack of sufficient knowledge caused the selection of an unsatisfactory material. In some cases this has been due to the user or the fabricator supplying incomplete information about the service conditions to the maker of the part or to the supplier of the material. There have been other instances in which the requirements have been such that no material in the plastics field could meet them adequately, but the best thing available has been used until development work could produce something better. Regardless of cause, these are the applications toward which the plastics industry is directing its educational efforts.

(3) There are a few unfortunate cases in which the fabricator was perfectly aware of the unsatisfactory nature of the material, but chose to make a temporary gain for himself by supplying it anyway. As no man can stay in business with such tactics, these have been fly-by-night operators for the most part, cashing in on the temporary demand for goods of every sort. They have done a great deal of harm to the industry.

In studying the misapplications of plastics two easily understandable points become apparent. Misapplications are (1) largely in the field of consumer goods, and (2) almost exclusively made with the lower-cost plastics. Sales of plastics parts made to industry are usually made upon a specification basis, after careful study of the material, and with adequate tests; the supplier is identified with

his product, and is dependent upon its performance for repeat orders and, indeed, for his business existence. The more costly plastics, such as nylon, the acrylics, polyethylene, and tetrafluorethylene, are seldom used without ample study of the application.

Examples of misuse of plastics involved such factors as disregard of their thermal limitations, migrating plasticizers, fading colors, and poor strength, poor shock resistance, and poor chemical resistance. This does not mean that plastics are deficient materials, but only that these properties, among others, have at times received improper consideration when the material was being studied for a particular application.

When one of the plastics families, the vinyls, was found to have elastomeric properties, efforts were made to fit members of the group into many of the applications for which rubber had been found successful. One of these was in the insulation of electrical cable. The sheath was extruded of resins of low molecular weight, the only type then available. While electrical resistance was acceptable, the sheathing had poor resistance to cutting, deformed at slightly elevated temperatures, and stiffened at low temperatures. The problem was solved by the development of another vinyl resin of higher molecular weight. That there was nothing intrinsically wrong with the first was shown by its later success as a lining in beer cans, and as the basis for the highly successful unbreakable phonograph record.

During the wartime shortage of metals, and especially of tin, an attempt was made to develop collapsible tubes of plastics. Cellulose acetate was chosen, and toothpaste was put up in the new containers. The plastics film was a poor barrier to moisture vapor, however, and the toothpaste dried out within a week. The same material gave satisfactory service as a grease container, however.

Plastic Buttons, An Example

Plastic buttons are a standard item, made by the millions. Molded buttons of phenol-formaldehyde resins are much used for men's suits and overcoats, and melamine-formaldehyde and urea-formaldehyde go into production of the lighter-colored buttons for women's clothes. They are highly resistant to water and to alkalies as in soap, and to organic solvents. They are sometimes rather brittle, and proper design is necessary to reduce breakage to a minimum. The sketch shows how a slight change in the design of a plastics button for the armed forces reduced breakage. The hornlike buttons of casein plastic were tough enough, but had very poor water resistance, and so were not widely used for garments that are to be washed frequently.

Cellulose nitrate has been used for buttons also, and became a storm center when its inflammable nature caused a serious accident. A housewife leaning over a heating unit was badly burned when a cellulose nitrate button on her dress caught fire, and the entire plastics button-making industry felt the effects. It was afterwards pointed out that the cellulose nitrate, while combustible, would not be ignited until a temperature had

Left—This clock case of molded cellulosic meets all of its service requirements. Right—For this telephone housing where service requirements are more severe, cellulose propionate is the molding material. (Photos: Courtesy Celanese Plastics Corp.)

been reached that would be sufficient to ignite the cloth of the dress, and cellulose nitrate buttons are still being made and used.

Polystyrene buttons have also caused some trouble in the button-making industry. Certain formulations of polystyrene are attacked by fluids used in dry cleaning, especially the chlorinated hydrocarbons now being used in many cleaning establishments. Production of polystyrene buttons was first limited to clear types, to avoid the damage to garments that resulted from bleeding colors. When it was found that the clear buttons would sometimes dissolve completely in cleaning preparations containing quantities of chlorinated solvents, especially perchlorethylene and trichlorethylene. More resistant formulations have now been developed.

One of the leading plastics manufacturers several years ago developed a phenolic especially to have low-loss electrical characteristics. It was made without any pigment, and with a mica filler. The natural color was a yellow-brown, and this color won recognition as indicating an excellent material for coil forms, radio applications, and aircraft electrical pieces. Another fabricator took a general purpose woodflour-filled phenolic, matched the color of the higher-priced specialty material, and made coil forms and similar items until users, unable to distinguish between the materials, became disgusted with the entire group of manufactured parts.

Industrial aprons made of low molecular weight vinyl resins with certain types of liquid plasticizers were tried in slaughterhouses and other places. It was found that contact with grease extracted the plasticizer, and the aprons were ruined. Use of a material of higher molecular weight and another type of plasticizer solved the problem. The same material that had been unsatisfactory in contact with grease was entirely satisfactory when used in shower curtains, where it was subjected to water only.

Plasticizers have caused trouble in other applications of vinyls also. Immediately after the end of hostilities a certain amount of vinyl resin was available for civilian use, but supplies of dioctyl phthalate, the plasticizer familiar as "D.O.P.," were very short. Some manufacturers began supplying "plastic patent," a glossy vinyl sheet much used for upholstery, women's pocketbooks, etc., made with low molecular weight resin and castor oil or any plasticizer available. The plasticizer came out after a short period, ruining any varnished surface in contact with it.

Of the same stripe was the use of butyral scrap from safety glass manufacture for sheet for pocketbooks.

An example of incorrect application of a plastics material due to a lack of complete information about the service requirements is found in the story of a closure for a perfume bottle. The perfumer wanted a molded cap of a clear plastic, and asked the materials supplier if a molded polystyrene would be resistant to alcohol. The plastics manufacturer, not knowing anything more about the use to which the material was to be put, answered that it would be. The perfume bottle closures were made up, and failed in service. When the plastics supplier investigated the failure, he discovered that the closure was required to withstand not only alcohol, but 3% of essential oil in the perfume. If he had been informed that oil resistance was a service condition also, he would have known that the polystyrene would not be suitable.

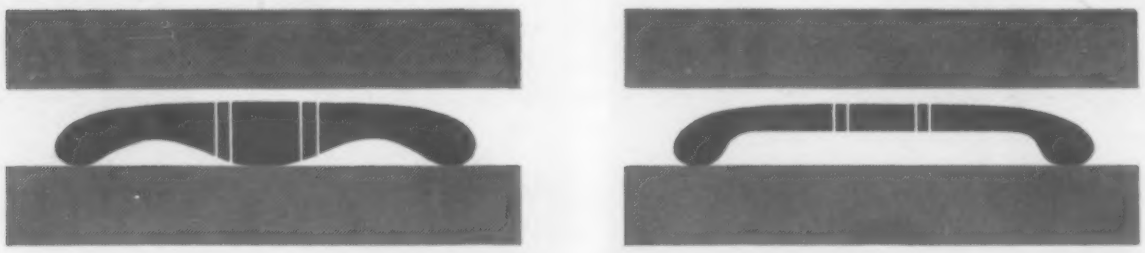
A humorous case of misapplication was reported by a large plastics manufacturer. A mistake in writing out an order caused a custom molder to purchase a quantity of a mold-cleaning compound instead of a molding powder he intended to order. The mold-cleaning compound consisted of a stiff resin with a small amount of a polishing agent added. The custom molder made up his parts with the cleaning compound, and ran several batches before the supplier, curious about the large orders for the cleaning compound, investigated and corrected the mistake.

The desire to cheapen an article to meet competition has occasionally led a plastics fabricator to use an unsatisfactory material. Plugs for attaching to electric irons and other heating units are ordinarily made of a mineral-filled phenolic, which has good strength and good heat resistance. When a molder tried to substitute a woodflour-filled general purpose phenolic the plugs charred at elevated temperatures, and the Underwriters' Laboratories quickly questioned the faulty parts. In a somewhat similar case, a switch plate was made of a woodflour-filled phenolic, which was perfectly satisfactory, but an attempt was made to cheapen the piece by using a thinner section. The switch plates broke too easily. A redesign finally solved the problem.

Sink strainers were tried in molded cellulosics, the acetate and acetate-butyrate, but were found to deteriorate rather rapidly in contact with grease. Washlines of extruded vinyl polymers stretched so much in hot weather, or under excessive load, that they were unusable, but cores of stranded wire or twisted paper made them an acceptable commodity.

All of these examples point out the necessity of obtaining complete information about service conditions under which the plastics part must function, and selecting the material honestly upon the basis of its suitability for those conditions. Any other course hurts both the individual fabricator and the entire industry.

A plastic button as designed at left will withstand stresses such as are incurred in pressing, while that at right, without a filled center, would break under bending pressures.



Are the H-Steels Being Accepted?

Buying and using steels specified according to hardenability limits seems to prove satisfactory from all viewpoints.

by T. C. DU MOND, Editor, Materials & Methods

● IT IS NOW about four years since a new idea in buying and specifying steels was introduced to the users of heat treatable steels. The new idea was in specifying steels according to hardenability rather than compositional specifications. Since well over 90% of the constructional alloy steel made in the United States is used in the heat treated condition, this change of concept could have an important impact on steel making and use.

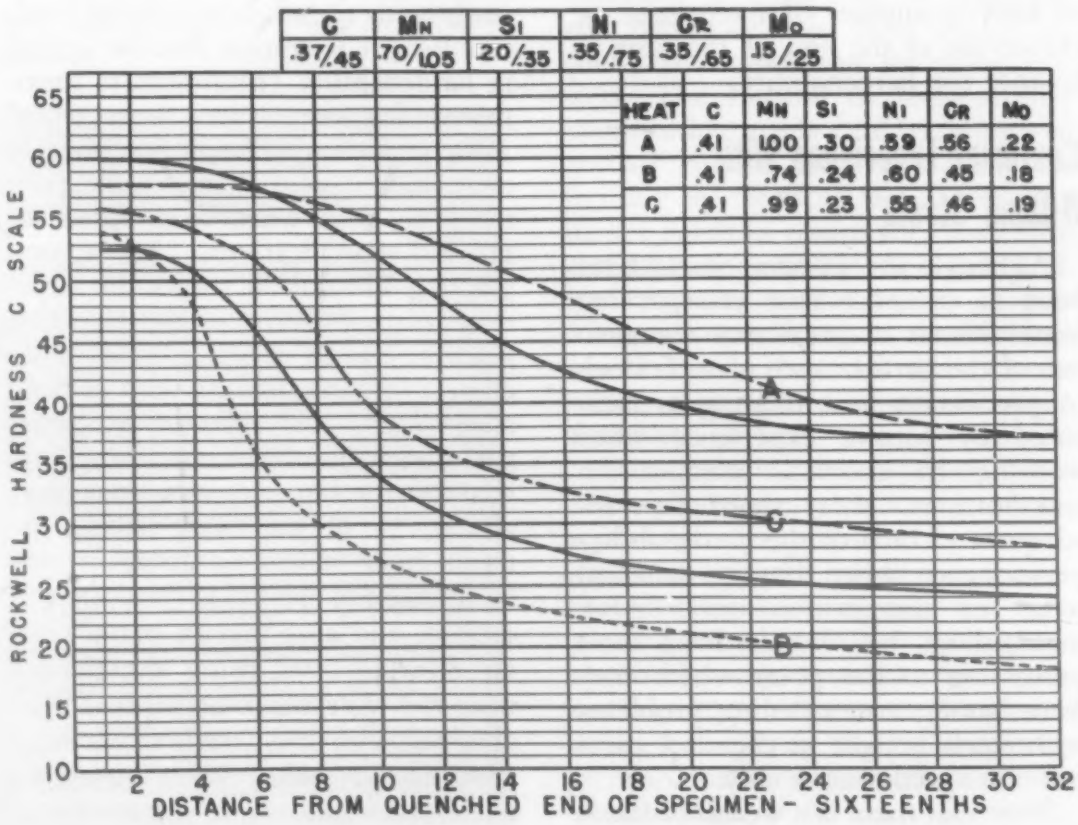
Over the years, the chemical analyses ranges of AISI-SAE steels have been tightened to the point where they can be considered to have reached a limit. That this is true is proved by the fact that 14 to 16% of the open hearth alloy steel produced falls outside of the established standard chemical ranges.

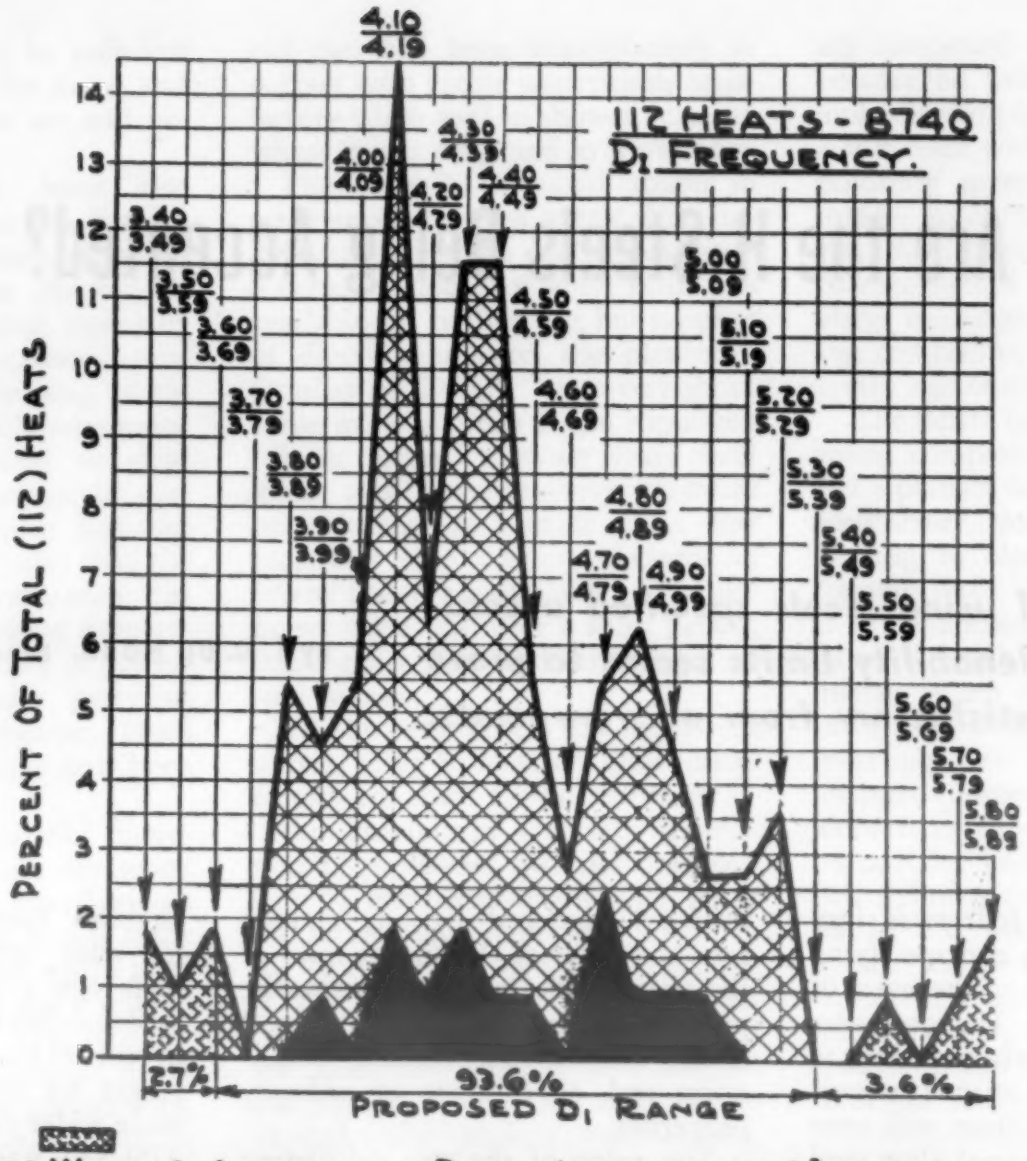
On the other hand, steels in which all of the alloying elements were within the specified limits failed to behave properly during heat treating. Paradoxically, certain of the heats which did not meet chemical specifications did respond satisfactorily to heat treatment.

The answers to these hardening problems seemed to be lurking in two relatively new methods of calculating and measuring hardenability. M. A. Grossman developed a method whereby the hardenability of a steel could be calculated from the chemical composition and grain size. W. E. Jominy and A. L. Boegehold perfected the end quench hardenability test. This latter test provides information about a heat of steel, including: maximum hardness and maximum strength; the hardness produced by any cooling rate; the effect of the size or mass of the part on the hardness obtainable; probable microstructure of the steel under known heat treating conditions; and, an estimate of ordinary properties.

The value of the two calculating methods in developing the NE steels during World War II led to the thought that they might be used to establish hardenability specifications for alloy steels. Thus, about four years ago a group of H-band (for hardenability) steels were established. In the H-band steels, the chemical ranges for individual elements were made wider than those of comparable AISI-SAE standard steels. This variation permitted heats outside of standard but within the hardenability limits to be used. Likewise, these

How heat treating results vary in steels falling within the specified compositional range is demonstrated in this graph. The heavy lines indicate the desired hardness properties in the steel.





When determining practical hardenability bands, research on 112 heats of steel showed that many heats within compositional limits failed to harden properly. On the other hand, many heats which were outside the compositional specifications hardened to well within desired limits.

wide limits permitted the steel melter to alter quantities of manganese or chromium at the end of the heat to balance the hardenability.

Customer Experience With H-Band Steels

Although the H-band steels have been in existence four years, it has been difficult to get a true comparison of the performance of such steels in production heat treating as measured by former experience when working to chemical composition specifications. Many shops kept inadequate records of the hardenability performance when buying standard steels to composition only. Also, many shops had standardized their processing to the point where they were having no hardening problems with steels bought to chemical composition specifications only.

Now that there is a wealth of hardenability data from hundreds of heats made with no effort to control hardenability, it is certain that the spread in hardenability (minimum to maximum) for any grade is some 20 to 30% greater with steels furnished to the standard steel chemical composition only than when working to the H-band specifications. An accompanying illustration shows the situation with 4140 vs. 4140-H. This grade is typical of all, and the closer control of hardenability with H-band steels should be reflected in better performance in the heat treating shop. It should be borne in mind that only about 7% of the heats having extreme high or low hardenability are being eliminated by H-band specifications, and also that in many cases no difficulty was being experienced with the wide range of hardenability obtained with steels made to chemical specifications only. With these two qualifications in mind, the results of a recent questionnaire sent out to 27 large users of alloy steels by the Steel Users' Subcommittee of Division III of the Society of Automotive Engineers is indeed surprising. Extracts from this report show that the H-band steels are performing as expected as measured by performance in the heat treating shop, which after all is the real criterion:

1. Elimination of Insufficient Hardenability

a. Carburizing Steels

(1) Low surface hardness—13 users commenting
Reduced rejections with H steels — 1
No difference — 5
Insufficient data — 7

(2) Low core hardness—10 users commenting
Reduced rejections with H steels — 4
No difference — 4
Insufficient data — 2

b. Heat Treating Steels

(1) Low surface hardness—14 users commenting
Reduced rejections with
H steels — 6
No difference — 2
Insufficient data — 6

(2) Low cross sectional hardness — 9 users commenting
Reduced rejections with
H steels — 5
No difference — 3
Insufficient data — 1

2. Effect of Hardenability Specifications on Warping and Cracking

a. Carburizing Steels

(1) Quench cracking — 14 users commenting
Reduced rejections with
H steels — 1
No difference — 9
Insufficient data — 4

(2) Distortion — 14 users commenting
Less distortion with
H steels — 6
No difference — 4
Insufficient data — 4

(3) Uniformity of distortion—13 users commenting
More uniform distortion with H steels — 5
No difference — 5
Insufficient data — 3

b. Heat Treating Steels

(1) Quench cracking — 14 users commenting
Reduced rejections with
H steels — 4
No difference — 3
Insufficient data — 7

(2) Distortion — 14 users commenting
Less distortion with
H steels — 5
No difference — 4
Insufficient data — 5

(3) Uniformity of distortion—13 users commenting
More uniform distortion with H steels — 5
No difference — 5
Insufficient data — 3

3. Machining, Forming and Straightening Operations—Two users reported less difficulty with straightening and three reported some improvement with regard to machining or forming of hot rolled or normalized bars purchased under "H" specifications.

4. Relation to Tempering—Six users reported fewer changes of tempering temperature with medium carbon steels, and one with carburizing steels.

In summary, the subcommittee reported—"On the whole, the answers to the questionnaire indicate that considerable improvement has been made in the elimination of the small percentage of heats, which are too low in hardenability to respond satisfactorily to production heat treatments. Distortion, warping and cracking have been somewhat reduced. This may be due in part to reduction of maximum hardenability; however, it is believed that the smaller variation in the hardenability of steel obtained from different producing sources is an important factor."

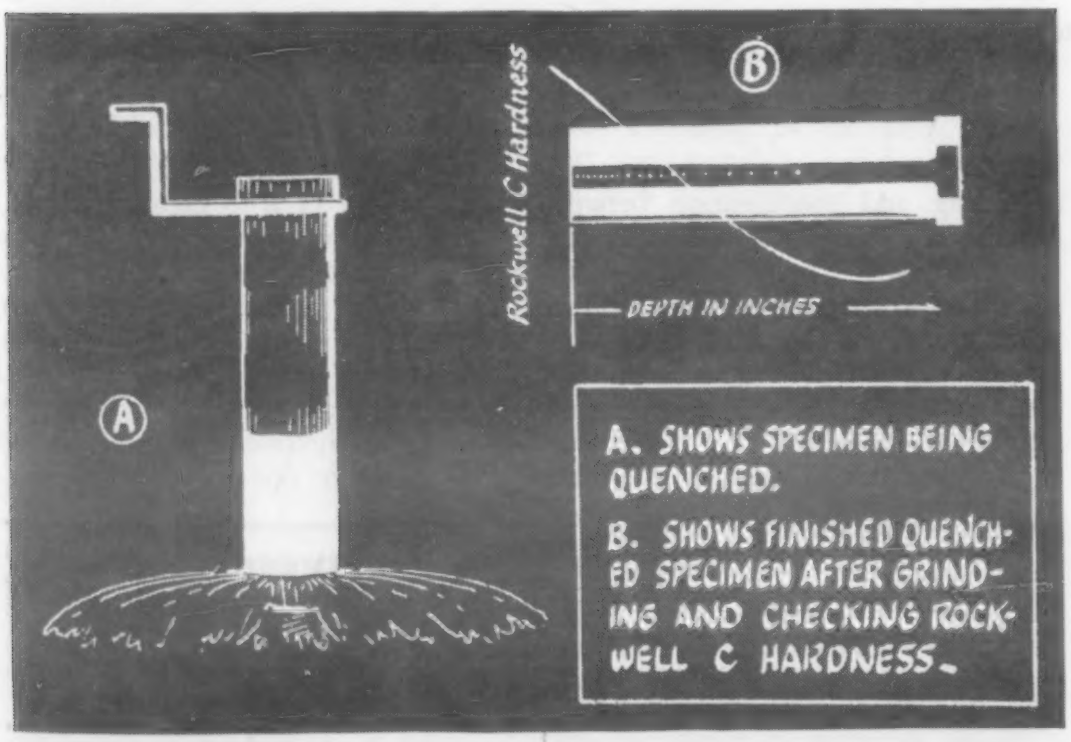
It seems evident from the opinions expressed above by large users of alloy steel who have purchased steel for the same parts by both chemical specifications and more recently to H-bands that closer control of hardenability is giving the user a product that is more satisfactory in heat treating. In addition, one of the conclusions stated by A. L. Boegehold recently was that "Ordering steels by the H-band offers opportunities for obtaining desired results at lower cost."

Future of H-Band Steels vs. Standard Steels

The present trend shows an increase in the tonnage of H-band steels as more and more users find that what they need is control of mechanical properties in their parts, and the H-band steels are better suited to the purpose. On the other hand, there are many jobs where the greater variation in hardenability encountered with steels ordered to the AISI-SAE chemical specifications is tolerable and they may need close control of chemical composition for other reasons. The H-band or hardenability specification steels can be improved further only if users will allow the latitude in chemical ranges the steel maker needs in return for closer control of hardenability. Specifying alloy steels to hardenability, or performance specifications, is no more revolutionary than the methods the melter must use to meet such specifications.

By continuing the excellent cooperation between producer and consumer on this problem, America is again leading the world in pioneering this field. The user can now specify alloy steels to the tightest chemical ranges possible with present-day knowledge of melting steel or he can specify the tightest range of hardenability possible with the present state of the art.

The simple Jominy hardenability test will tell maximum hardness and maximum strength; hardness produced by any cooling rate; effect of size or mass on hardness obtainable; probable microstructure of steel under known heat treating conditions; and an estimate of ordinary properties.


Rockwell C Hardness
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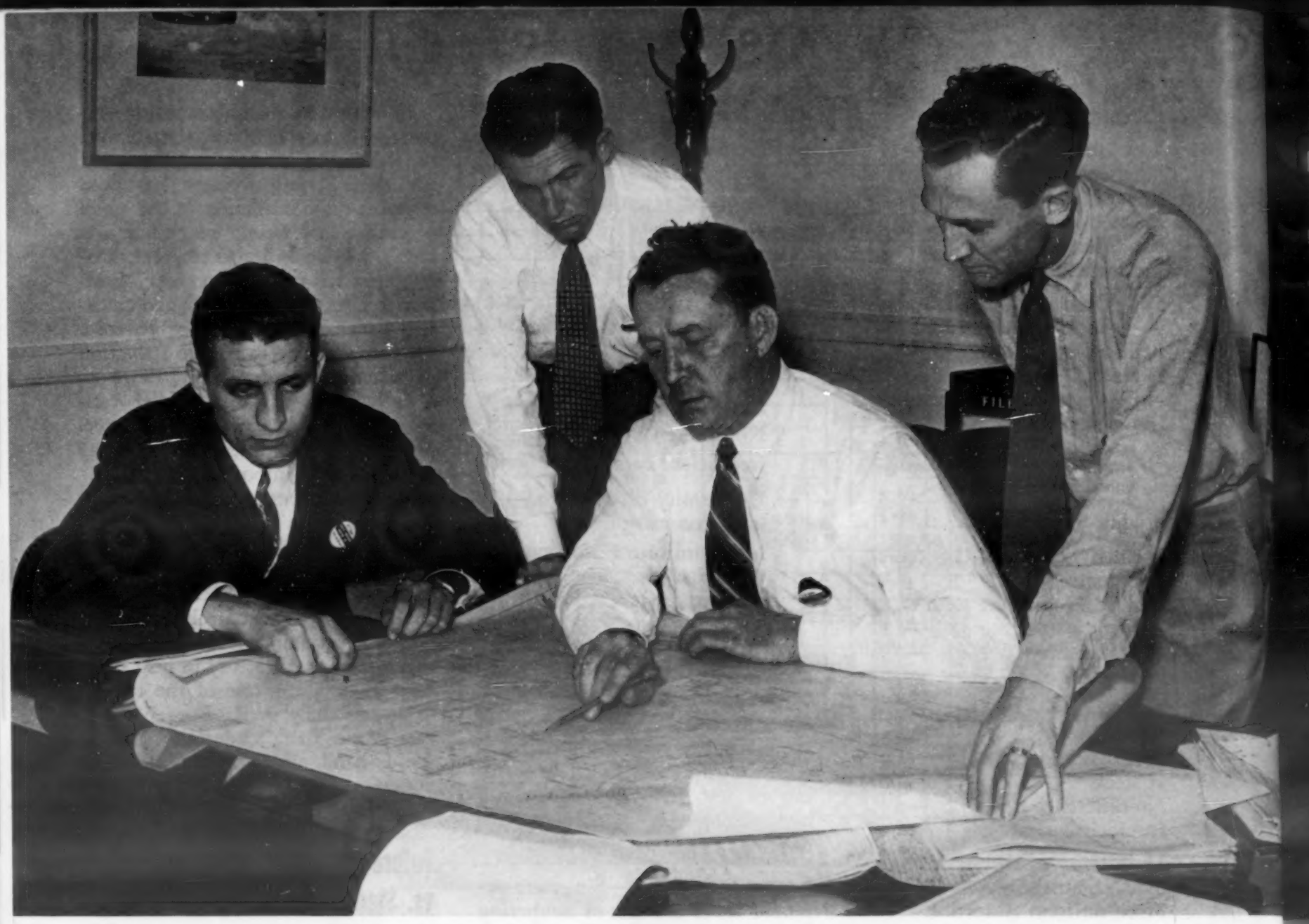


Proper engineering and efficient production of a product calls for close cooperation between the technical men responsible for materials, design and processing. (Courtesy: North American Aviation, Inc.)

Needed—More Coordination Between Materials, Design and Processing

by H. R. CLAUSER, Associate Editor, Materials & Methods

● THAT DESIGN, materials and processing must advance together for best results would appear to be self-evident, and yet probably more often than not the tendency is for each of these to proceed along its separate path with only a perfunctory interest in its relation to the other two. Lack of coordination between the three elements, which enter into the engineering of every product, frequently passes unnoticed, because often no easily recognized harm or inefficiency results. However, the unprecedented demand made in recent years on materials, design and processing has resulted in some serious failures that can be directly laid to lack of understanding and coordination between them. Not only is close cooperation needed to avoid such service failures, but also to meet present and future production and performance requirements in such new fields as nuclear energy, gas turbines, and supersonic flight.

To say flatly that one or the other of the three is not keeping pace with the others, or is to blame for lack of coordination, would be a rash statement indeed. For it is a matter that cannot be settled so easily. Therefore, the intent here is not to pass judgment, but rather to survey the general picture by citing a number of representative cases and thereby show where one may be lagging or

Is closer coordination needed between the three vital factors that enter into the engineering of every product? This article says "yes", and gives a number of cases that explain why.

Mechanical design details must take into account both service properties and processing characteristics of materials involved. (Courtesy: Heintz Mfg. Co.)

where greater coordination between all three is needed.

The Case of the Welded Ships

Perhaps the best example of the close interdependence of materials, design and processing is the case of welded ships. The loss of a number of merchant ships during the war due to their breaking apart in service received nation-wide attention, and even induced Congress to conduct a committee investigation into the cause of the failures.

Many people hastily concluded that welding was the cause of the failures. However, extensive investigations were conducted by several agencies, and in 1946 a final report was submitted to the Secretary of the Navy which clarified this highly controversial subject by arriving at some clear-cut and well-substantiated conclusions. For one thing, the report fully vindicated the all-welded ship as such; it showed that with proper design, high quality workmanship, and a steel with low notch-sensitivity at operating temperatures, a satisfactory all-welded ship structure can be obtained.

Perhaps the most important single finding was that the fractures in welded ships were brittle failures caused by steel that was notch-sensitive at service temperatures. However, this wasn't the full story, for it was found that the fractures usually occurred as a result of design detail which did not take into account the notch-sensitivity of the steel. Also, poor workmanship was a cause to a relatively minor degree.

An important conclusion to be deduced from these findings is that designers and production men must have a knowledge of the materials with which they are working. In this case either there was an improper selection of material, or the properties of the material were not thoroughly understood and considered in the design details. And, to a lesser extent, the notch sensitivity of the steel was not sufficiently considered in fabricating the ships. In any event, much trouble might have been avoided by full consideration of the interdependence of materials, design and production methods.

Gas Turbines

Probably nowhere are design, materials and processing more closely connected than in the design and production of gas turbines and jet engines, and further progress here depends upon the joint advance of all three. It is well known that the development of an efficient gas turbine for use in aircraft had to await the development of materials with properties that would give adequate life under severe high temperature operating conditions. Although materials have been developed to meet performance requirements for military aircraft that have lives of from 200 to 400 hr., the problem still remains for practical peace-time applications. Gas turbines for ships, railroads and stationary power generators to be practical must be designed for 10 or more years, but high temperature alloys with their limited creep, fatigue and corrosion properties still cannot approach this service life.

For most efficient operation gas turbine designers would like to design for operation somewhere above 3000 F, but even the best materials available now are not good for much above 1500 F. There have been a number of design advances involving methods of cooling various critical parts of the assembly; for example, in design of blades and in construction of gas ducts in the turbine housing by using a double wall to allow the inner hot surface to be cooled. But there is a limit beyond which such design compensations cannot go, and it remains a matter of developing better materials before the next big steps can be taken.

But even the development of materials to meet the severe operating conditions only partly solves the problem. In recent years a number of new alloys have been accurately reported as having "outstanding" properties, but nevertheless have not proved commercially feasible either because of the difficulty of manufacturing them in large quantity or because of their inability to be properly worked and fabricated.

Ceramic materials, for example, are in many respects superior to metallic materials for high temperature service and have a promising future in this field. But their rapid advance is being hampered by at least two processing problems. These are (1) the problem of forming certain shapes, such as thin twisted airfoil shapes that are necessary for high operating efficiency; and (2) the problem of joining ceramic parts, *i.e.,* the fastening of ceramic blades to the metal disks.

Use of many high temperature metallic alloys is also being restricted by the inability to work them and still retain satisfactory performance properties. The problem of forgeability has been partly solved by use of heat treatable alloys. However, in castings as well as forgings there is the problem of obtaining optimum structure and maximum cleanliness through proper processing techniques and procedures.

Therefore, it is evident that in this field, design, materials and processing must advance together. As new materials are developed, methods of processing them must also be introduced, and at the same time the shortcomings compensated for by judicious design.

Processing Characteristics Important

Another example of the close connection between the three factors is in the field of working and forming metals, where the engineer in his design and selection of materials frequently fails to take into account processing methods. This has and will lead to inefficient production; or where processing affects end properties, it can result in service failures. A large part of the trouble has been lack of practical methods for determining the fabricating characteristics of a material on actual parts.

The problems of metal forming have been multiplied in recent years by introduction of product designs that involve more complicated shapes as well as many new higher strength materials. This, out of necessity, is fortunately resulting in more consideration being given to forming and its relation to design and materials. Evidence of this is the attention given during and since the war to the detailed study and application of fundamental concepts of flow and metal deformation to metal forming applications.

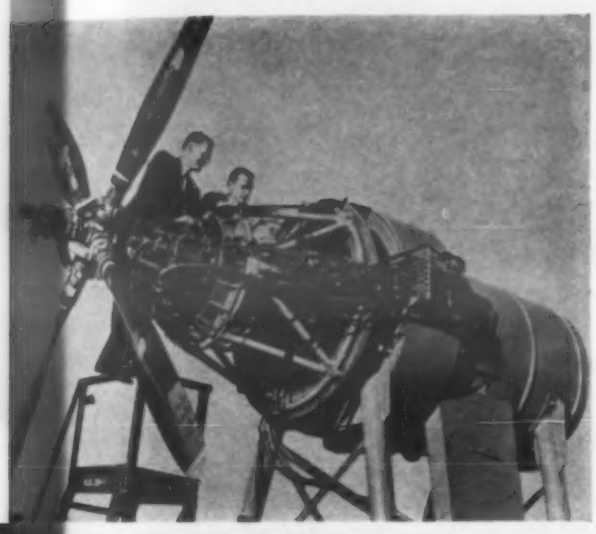
Original data for such studies are

The introduction of more complex shapes is resulting in more consideration being given to metal forming and its relation to design and materials. (Courtesy: Inland Steel Co.)

usually obtained by use of photographically gridded sheets which are fabricated as required and the resultant strains analyzed. Going beyond this, new test methods have been developed which simulate the forming stresses and strains in terms of uni-, bi- and tri-axial stresses. These methods have been applied to drawing of aluminum and magnesium alloys, as well as to steels.

This type of data if used by the engineer will go far to aid him in his design work. Thus, if the design must be fixed for functional reasons, material selection will depend almost

To meet the severe requirements of gas turbines, design, materials and processing must advance together. (Courtesy: General Electric Co.)



entirely on the design stresses. On the other hand, if the material is fixed for reasons other than strength, then the deformation limits will be the guide to the best design. In addition, this data on forming properties of materials will also extend, in many cases, the use of press forming and severity of forming operations.

Many examples could be cited in which inefficient methods were long used through failure on the part of production to understand or apply information and data on the processing characteristics of materials. One typical example involves the cutting speed for machining aluminum. For many years it was recognized that aluminum could be machined at unusually high speeds. However, cutting speeds above 7500 ft. per min. were seldom used until through the pressure of war production speeds as high as 14,000 to 18,000 ft. per min. were tried and found perfectly satisfactory. Thus, previous production rates were at least doubled.

There are some fields of processing where many are convinced that no more major improvements can be made with present-day materials. Heat treating is one field frequently mentioned in this respect. In recent years heat treating has made great strides with the introduction of interrupted quenching, automatic heat treating methods, and building heat treating operations directly into the production line. While, no doubt, further developments and refinements of existing methods will be made for the improvement of material properties, the maximum amount of improvement appears to be limited to not much more than 10%. This is not sufficient to meet the design requirements of such things as future nuclear power plants, gas turbines and rockets. Therefore, major heat treating advances must await the development of new materials.

Design and New Materials

That design fails to take advantage of new materials is a subject that has been widely discussed pro and con in recent years. While not wishing to take a stand either way on this subject, it might be said that designers, like all engineers, tend to be conservative. They are prone to continue using and specifying the same materials if they have proved satisfactory in the past; they hesitate to abandon them for materials with which they are less familiar. Consequently, where older materials will do the job, they are often selected in preference to new and better ones.

Generally, it is in those cases where older, conventional materials cannot meet the requirements that design most quickly accepts new materials to solve its problems. The case of gas turbines, already discussed, is a good example. And it is generally true in the aircraft industry. Because of their special requirements, such as weight limitations, the industry out of necessity has always sought better materials and fostered close coordination between design, materials and production methods. This has already been shown in our discussion of studies being conducted on the forming properties of metals, which were largely initiated in the aircraft field. Another example is industry's present interest in many new materials—to mention a few, low pressure plastic laminates, molybdenum, and titanium. Titanium is of such great interest because it is the fourth most plentiful metal, and it has a modulus of elasticity and density intermediate between aluminum and steel, likewise, molybdenum because of its elastic modulus of around 50 by 10^6, strengths above 100,000 psi. with alloy additions, and its relatively good formability.

In many respects, the transportation field has been slow in adopting both new materials and processing methods. Although new passenger car designs are now beginning to take advantage of light metals, stainless steels and welding, it was a long, slow step. In freight car design much more could be done, particularly by the wider use of the so-called high strength, low alloy steels. It has been proved, for example, that the weight of a freight car can be reduced by 13,000 lb. by use of these steels. This would mean increased operating efficiency; also probably longer life, and lower maintenance costs because of the superior properties of these steels.

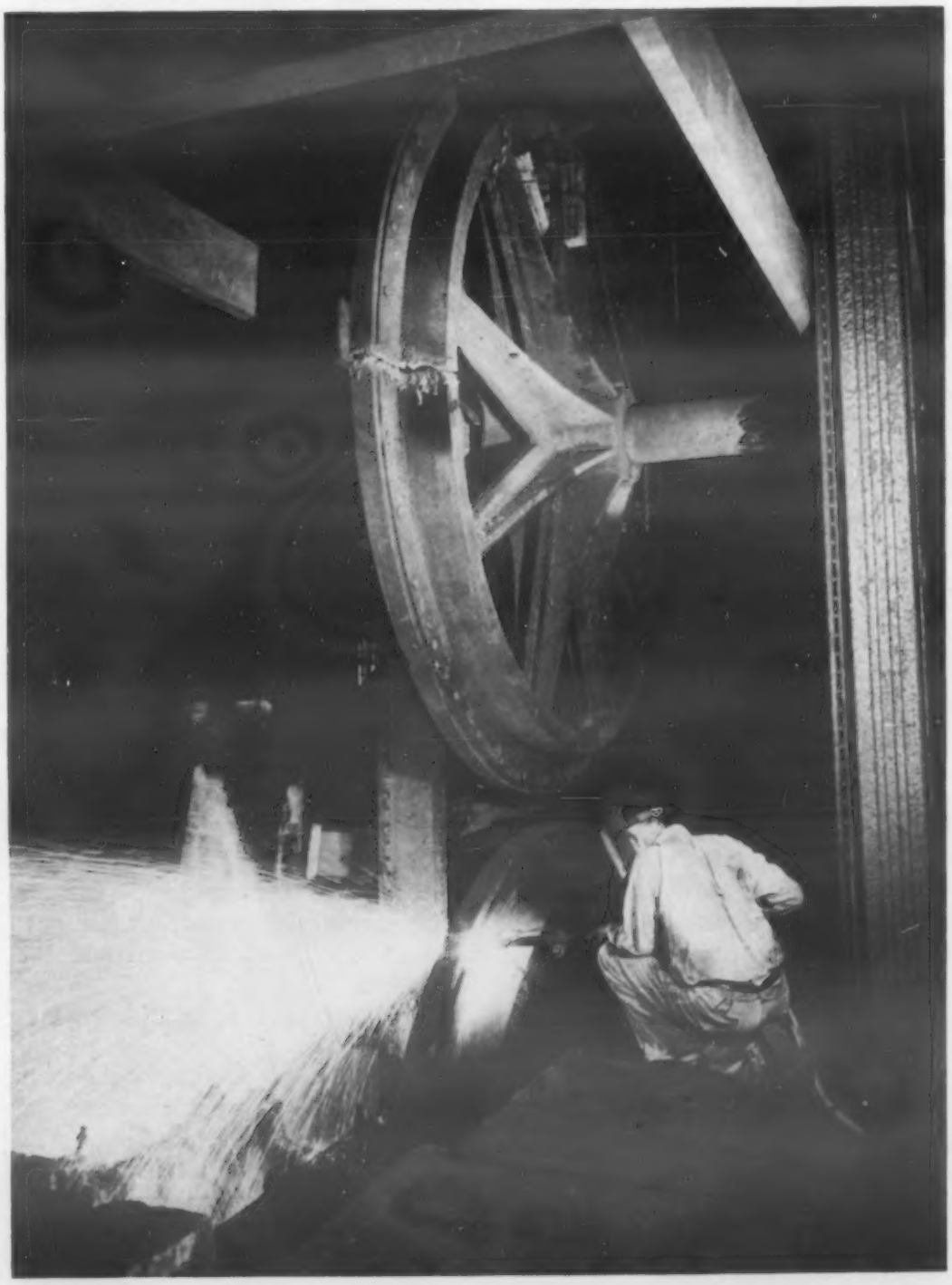
The automotive field is frequently backward in incorporating new and better materials into their designs. There have been moves to adopt high strength, low alloy steels, but usually only as a substitute when carbon steel was not available. In some of these cases the results were unsatisfactory, because the different forming properties of the steels were not considered. High strength, low alloy steels have more springback, for example; consequently, where dies and forming techniques for carbon steel were used, fabricating difficulties were encountered and poor results obtained. However, by designing specifically for these high strength steels, and by understanding their operating characteristics, the change-over can be made without difficulty.

Whether or not automobile design has taken full advantage of light metals is open to debate. For the automobile industry has a complex set of factors that govern their design and production. They are paramountly concerned with cost and ease of production. And on top of these they must consider customer tastes and preferences. Therefore, it is not only a matter of whether aluminum will perform better than steel. In addition, it must be at least equal in both cost and ease of fabrication. Thus, where a part will function better if made of light metals instead of steel, it becomes largely a problem of designing and producing the part in such a way as to overcome the objections.

Therefore, here as in all the other cases previously described, the proper engineering of a product vitally depends on coordination between design, materials and processing. And to meet the present and future revolutionary demands, it is even more important now than it was in the past.

Materials at Work

Here is materials engineering in action . . .
New materials in their intended uses . . .
Older, basic materials in new applications . . .

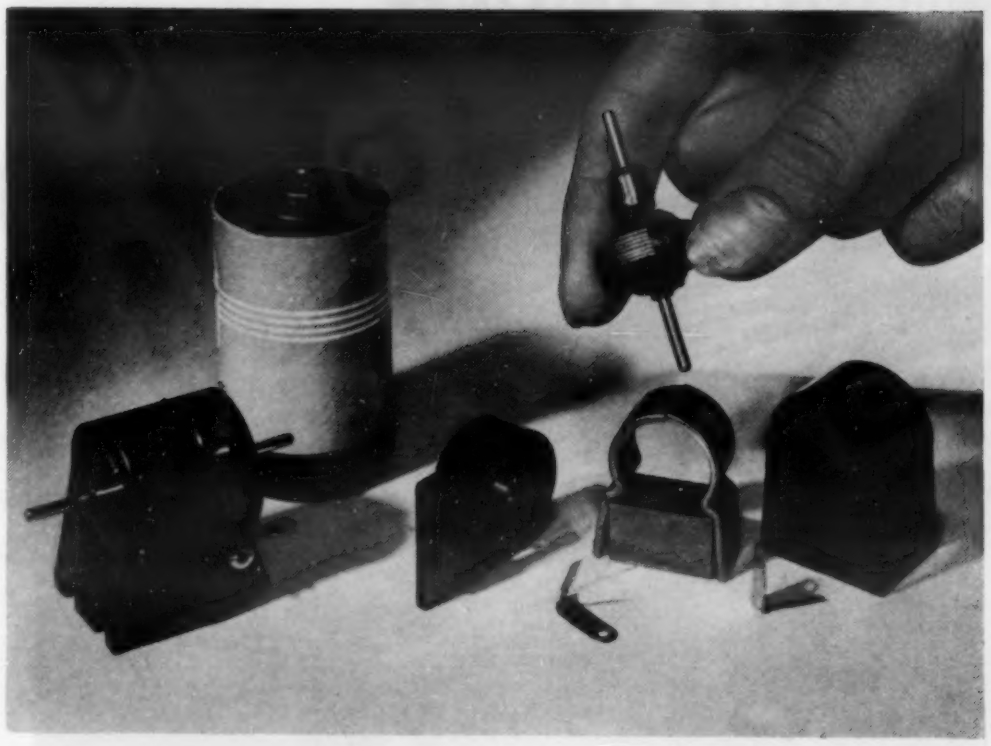


POWDER-CUTTING CAST IRON

Scrapping large cast-iron wheels, each 10 ft. 6 in. in diameter and weighing close to 5 tons, presented a problem to the Bates Expanded Metal Co., East Chicago, Ind. After two unsuccessful attempts by other cutting methods, four powder-cuts were made in each rim, 13 in. at its thickest section, with a Linde Oxweld cutting blowpipe equipped with powder adaptor. Each rim-cut took about 12 minutes to make. Following this, the hub was split and the spokes cut off at rim and hub to complete the scrapping job.

CELLULOSE ACETATE MOTOR HOUSING

Encased in a heat and flame resistant plastic, this 2-oz., flashlight-battery-operated motor develops up to 7000 rpm. and 1/100 hp. It is made by Arpin Products, Inc. The housing is injection-molded in two sections from Lumarith XF. This plastic, a product of Celanese Corp. of America, combines the characteristic flame-resistance of thermosetting materials with the form-retentive qualities and moldability of the thermoplastics. Disassembled components of the motor shown include magnetic field, combination contact brushes, case, and rotor which measures less than ½ in. in dia. and is wound on a standard armature. In tests, the motor ran continuously for more than 300 hr. without a breakdown.



ALUMINUM-BRONZE SWITCH BUMPER

Subjected to extremely severe use due to rapid operation of a Cutler-Hammer electrical switch, this small bumper or backstop pad formerly peened or mushroomed from constant switch action and resulted in faulty electrical contact and accentuated wear on other parts. Ampco Metal Grade 22, an extremely hard aluminum-bronze alloy of Ampco Metal, Inc., was substituted to prevent further failures of this type. The alloy has an average tensile strength of 85,000 psi. and an average yield strength of 70,000 psi. It tests an average of 331 Brinell with a 3000-kg. load and an average of 35 Rockwell C by conversion.

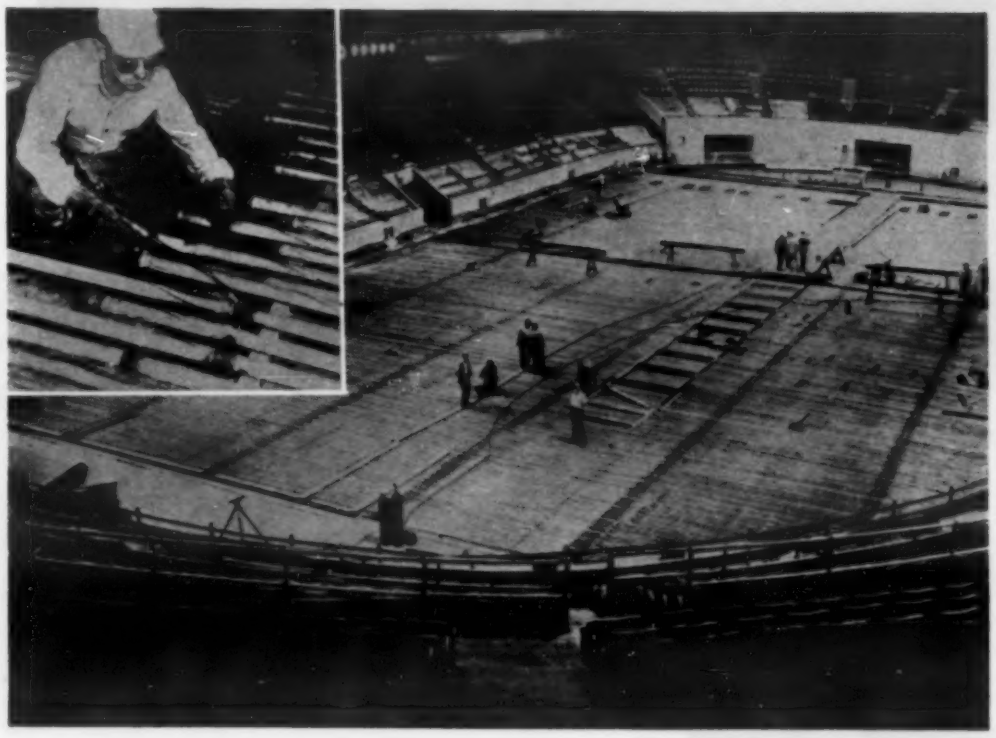
STAINLESS STEEL WASHFOUNTAIN

Reportedly one of the largest single pieces of deep-drawn stainless steel, this washfountain bowl was produced by the Bradley Washfountain Co. The bowl, 54 in. in dia., is drawn to a depth of 10 in. from a 67-in. blank of 13-gage metal of the 18:8 type in one operation on a 1200-ton hydraulic press.

STYRENE PIPE

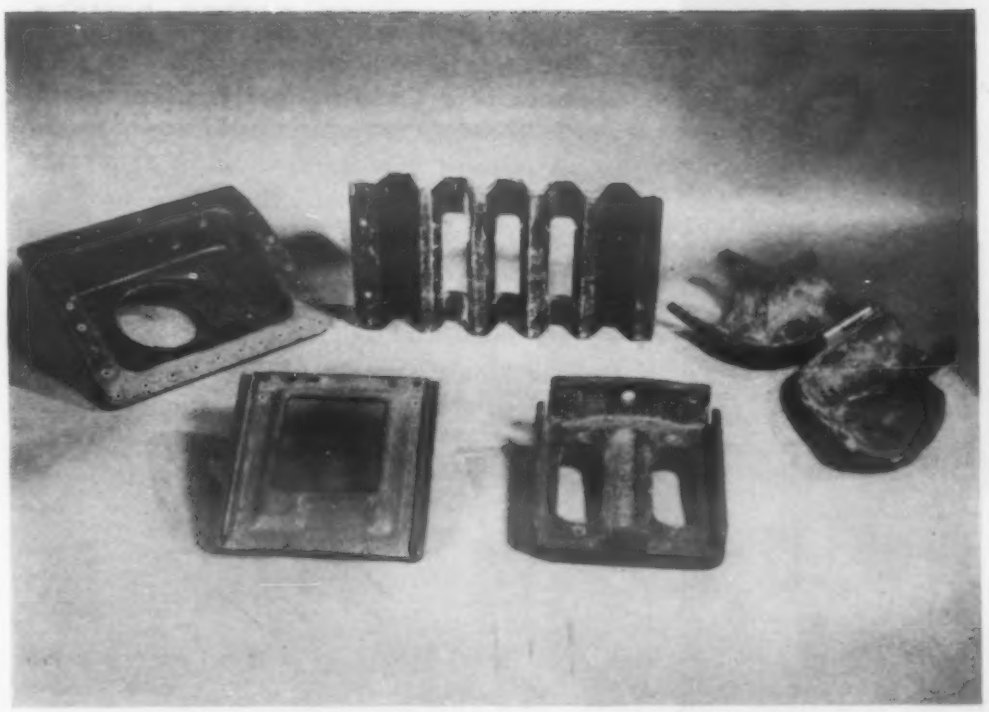
Withstanding working pressures to 650 psi. at temperatures to 100 F, this Extrulite pipe will safely handle water, natural or manufactured gas, organic solvents, or alkalis. The unlined, rigid pipe, a product of Extruders, Inc., Culver City, Calif., can be made up with standard dies, tees, elbows and joints. High-impact, light-weight, and easy-threading characteristics of this material provide rapid assembly of permanent or temporary piping arrangements.

Materials at Work



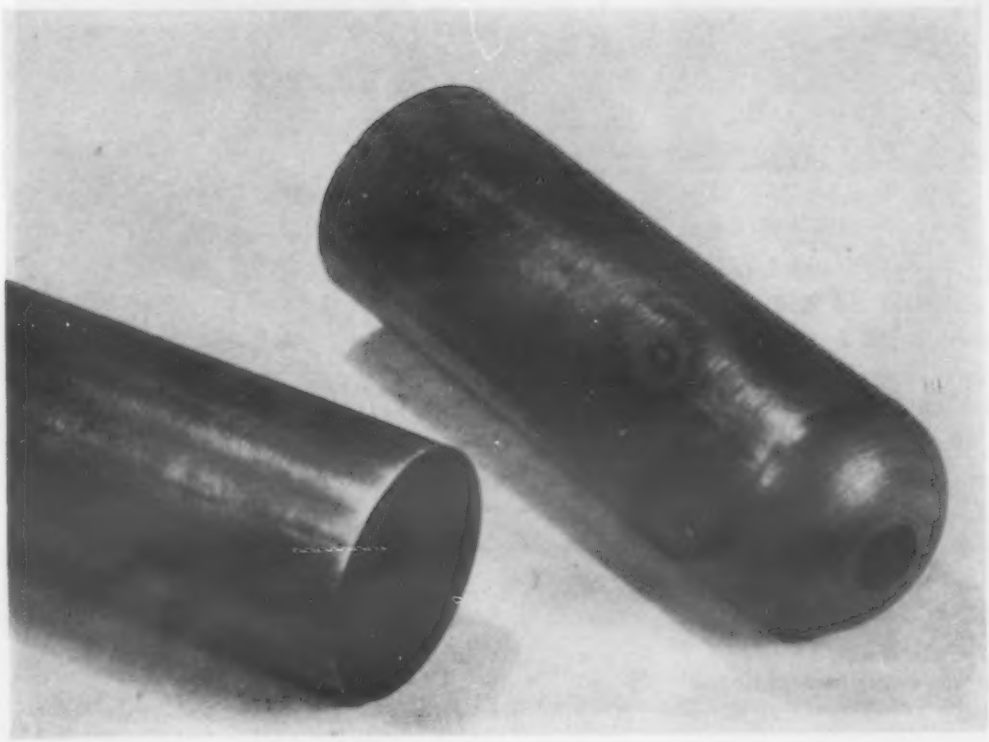
BRAZING WROUGHT IRON PIPE JOINTS

Thread cutting was eliminated and full wall thickness retained when joining the wrought iron pipe in the concrete-embedded piping system for freezing ice recently installed in Madison Square Garden, New York. The 13 miles of 1¼-in. galvanized piping, placed 4 in. on centers, required to cover the arena floor used 3000 Easy-Flo brazed Flagg-Flow threadless malleable iron fittings to join the 20- and 40-ft. pipe lengths. Leak-tight joints were obtained between pipe and fittings by sweating in the high-strength silver brazing alloy with oxyacetylene torches. During fabrication and after completion of the job tests were conducted. These included a preliminary "suds" test under 100-lb. air pressure followed by 100-lb. hydrostatic pressure tests, twice the normal working pressure. Few leakers occurred; these were repaired by reheating and reapplying brazing alloy. After testing, the system was embedded in concrete and topped with terrazzo. The new floor and piping system, subjected to wide weight, vibration and temperature variations, is expected to outlast the threaded-joint construction previously used.



GLASS CLOTH-POLYMETHYL METHACRYLATE LAMINATIONS

Tools and aircraft parts in complex shapes and sizes are produced at Republic Aviation Corp. by low pressure welding of glass cloth laminates with du Pont BCM, a polyester resin, as the bonding agent. Two methods are used in making the molded parts: bag molding, and mated die molding. Laminated parts find their best application in electrical items such as covers, boxes, panels, wire guards, or fairleads, and in manufacturing tools and jigs such as the drilling and routing fixtures shown.



SPINNING STEEL TUBING

Heated steel tubing was formerly spun with tungsten carbide tools, but the carbide oxidized and cracked under the high heat and pressure after only 4 hr. of use. This constituted total tool life, as regrinding was found to be impossible. To improve production and eliminate short tool life, Kennametal High Temperature Grade K138 was used in the spinning operation. This resulted in 15-hr. service before regrinding was necessary; and from five to eight regrinds per tool were possible in contrast to the limited service formerly obtained. In the spinning operation, the tubing was chucked and rotated at 600 rpm. under heat from an acetylene torch. With the rotating tube at proper temperature, the tool was forced against it and swung in an arc, by the pivoted tool post, to form the required tube-end radius.

Materials & Methods Manual

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and application

45

Review of Materials Engineering Developments in 1948

by the Editors of Materials & Methods

Improvements in materials, their processing and fabrication made during 1948 will make themselves felt more strongly this year and in years to come. Presented in this section as a refresher report are the highlights of 1948 developments.

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Trends in Materials and Their Processing

From out of the welter of confusion which surrounds the continuing scarcities of metallic materials there appear a few well-defined trends. The trends to be cited are by no means the children of 1948, they merely emerged from their swaddling clothes and made their presence more definitely known.

In the realm of materials engineering the search for materials that are light and strong, corrosion resistant and easy to work continues at an intensified pace. Where not all of these admirable qualities are to be found in one material, it must be outstanding in one or more of the desired characteristics.

As far as processing of fabricating materials is concerned, the outstanding desire is for closer control. Compositional or hardenability control are important, but increasing emphasis is now placed on control over final shape of the part as it comes from the mold, machine, press or forge.

On top of these, efforts are constantly being made to increase the sizes possible by various production means. Die castings, plastics moldings, precision castings and forgings are all being made larger. As size is increased accuracy is also increased, and in many cases cost and waste are reduced.

Illustrative of the eagerness with which industry grasps new materials which promise outstanding properties is the rush to acquire information about titanium metal. While still far from being in commercial production, many companies have announced their intention of producing the metal. All of our armed forces are investigating the use of titanium for every conceivable task, and many researchers are at work checking on the properties of the material and seeking ideal alloys, as well as looking for suitable applications.

While titanium is still in the future as a material for everyday use, 1948 did see the issuance of several new materials, both metallic and nonmetallic. The newcomers include several plastics which are suited to use at temperatures far above previous working limits, cast iron that resists growth at elevated temperatures, and nodular graphite cast iron which has properties vastly superior to cast irons of similar basic compositions. Likewise, there became available a new steel which combines hardness and toughness, particularly at strength levels over 200,000 psi.

The use of magnesium was extended during the year through perfection of methods of brazing and plating the light metal. Methods of doing these jobs had been sought for years. While the alloys to which brazing can be applied are few, this step will undoubtedly lead to more extensive application later. Also adding to the usefulness of magnesium are two new magnesium alloys. One is said will raise the effective working limit of magnesium 300 F above existing limits; the other will be used for structural parts of aircraft.

One of the outstanding developments of the past year has been the manner in which aluminum has found new applications. New uses came at such a rate that whereas aluminum supplies were ample at the start of 1948, the demand caught up with and passed the supply in mid-year. Qualified observers feel that a large percentage of the increased use was in permanent applications based on sound engineering values rather than being due to substitutions induced by shortages.

From the standpoint of materials production, most producers are extending all possible effort towards increasing output. In addition to building new facilities, modernizing existing plants and increasing the output of old mills, new production methods are being introduced. Continuous casting of semi-finished steel is an example. While still in its early stages, this latter step holds the promise of being the answer to some of the problems which will face the steel industry in coming years. Above all, the steel attained is somewhat superior to that produced by normal production methods.

Stainless steel is finally achieving the place on the materials scale long predicted for it. Here is another case of a material which was readily available early in 1948, entering the scarcity list before the year had passed.

Much of the steel consuming and using industry is at a standstill as far as future plans are concerned due to the unsettled pricing situation caused by a U. S. Supreme Court decision. If steel producers are forced to continue selling on an F.O.B. mill basis, some mills will revert to purely local businesses, and large users of steel may be forced to locate at least a portion of their production facilities close to a steel mill.

Most industry enters 1949 with a questioning attitude. Here are some of the questions which up until now remain unanswered: Will business remain at a high level? Will materials prices continue to rise? Will government stockpiling interfere with the procurement of materials?

Whatever the answers to these and other vexing problems may be, it is reasonable to assume that the next year will continue to see rapid progress in all fields of materials engineering.

Iron and Steel

Despite, or perhaps because of, the plaguing steel shortage which continued throughout all of 1948, many advances were realized during the past 12 months. It was to be expected that much effort would be devoted to increased output of existing blast furnace and rolling equipment. These efforts met with results, but of greater future value is the friction of searches for new metal producing techniques.

While the major attention was devoted to turning out more steel than had ever before been produced in this or any other country, progress continued in alloying and utilization of steels and irons.

Materials Developments

After many years of experimentation, the combined efforts of Republic Steel Corp. and Babcock & Wilcox Tube Co. resulted in a successful method of continuous casting of semi-finished steel. Although the development was not announced until late summer, the first shipment of bars produced in this manner was made in March. This permitted sufficient time to test the product before any public information was divulged.

From the standpoint of steel making, the method gives some promise of making less costly any decentralization of the steel industry. Even without decentralization, the process may be one answer to keeping steel prices down despite universally rising costs.

However, the advantages are not all on the side of the steel maker. The user will benefit through a steel which is of a finer grain than normal. In addition, there seems to be less segregation and fewer inclusions in the steel made by continuous casting. At present, rounds and flats are being produced.

The materials engineering field had heard for many months of a new steel which was both hard and tough. In October details of the steel with these normally incompatible characteristics were made known by Crucible Steel Co. of America. Hy-Tuf, as the steel is known, contains 1.80 nickel, 1.30 manganese, 1.50 silicon, and 0.40% molybdenum. When heat treated and oil quenched from 1575 F, and tempered at 550 F, Hy-Tuf shows the following properties:

0.2% yield strength, psi.	193,000
Tensile strength, psi.	234,000
Elong. in 2 in., %	13.1
Reduction of area, %	49.7
Rockwell C hardness	46.5
V-notch Izod at 70 F, ft.-lb.	31.

Hy-Tuf is at its best when heat treated to high strengths and offers little advantage at strength levels under 200,000 psi. It has better notch impact resistance than normal steels when heat treated to the same high tensile strength; likewise, it shows less notch sensitivity.

This new steel can be readily welded by flash welding and arc welding despite its high hardenability. It can be cyanided but it is not economically practical to carburize for higher hardness.

Early in 1948 Carpenter Steel Co. announced that it had perfected manufacturing techniques to produce Durimet 20 stainless steel in many wrought forms. Previously Durimet 20 had been available only in cast form. Now available as bar, wire, strip, tubing and pipe, the material is labeled Carpenter 20.

The outstanding characteristic of Carpenter 20 is its resistance to the corrosive action of sulfuric acid. Therefore, it is expected to have wide application in the heavy chemical industries.

Carpenter 20 is machinable, can be hot forged, is readily welded and can be formed at room temperatures. Water quenching from 2100 F develops maximum corrosion resistance in this stainless composition. Since the ideal heat treatment is given the steel during its manufacture, no heat treating is required on the part of the steel's users. The only exception is after drastic welding when treating might become necessary.

Although Carpenter 20 is now being produced only in the wrought forms listed previously, techniques for producing it in sheet are expected to be perfected in the near future.

Long tubular castings of stainless, tool, alloy and carbon steels, as well as alloy and gray cast irons and some nonferrous metals, are being produced by a new centrifugal casting process developed by United States Pipe & Foundry Co. The process is useful in providing combination materials in which a shell of one material is lined with another material.

In the process a refractory coating is applied to the interior of a heated metal mold. The coating material helps traction and provides momentary insulation. Coatings vary from 0.01 to 0.08 in., depending upon the material being cast and the size of the casting. Practical size limitations at the present time are 3- to 24-in. outside dia., 8-ft. length and $\frac{3}{8}$- to 2-in. wall thickness.

This new development is most suited to the production of tubing from the high alloys—at least from the cost standpoint—since the method is too expensive to compete against thin wall seamless or welded tubing.

To provide nitriding steels with good machinability, the Nitralloy Corp. developed a steel composition known as graphitic Nitralloy. This new steel can be partially graphitized by a simple heat treatment. The result is a steel which has the strength and hardness of nitrided Nitralloy plus high machinability. The graphite particles serve as a lubricant.

During the last year aluminized steel became available in another form which is suited to fabrication of small parts. A joint development of Sylvania Electric Products Co. and Armco Steel Co., this aluminized steel has a black finish. The black finish provides heat radiating properties 85% of those of the perfect black body. A low carbon steel is coated with an aluminum — silicon alloy rolled down and hydrogen annealed.

Cast Iron

The metallurgical goal of producing a nodular graphite in cast iron during the casting and solidification period seems to be closer to achievement from several directions. The A.F.A. meeting in Philadelphia was told of British progress in that direction by Mr. H. Morrogh. At the same time United States progress has reached the point where commercial tests are being made on nodular graphite cast iron.

Although different methods are used to achieve the results, the properties are reasonably close in the U. S. and British methods. In the U. S. process, a small amount of magnesium (or magnesium containing addition agents, such as a nickel-magnesium alloy) is introduced into the iron. Added in the proper amounts, magnesium increases the iron's strength several times and improves impact properties.

Properties vary in accordance with the base material, but a base iron which has an as-cast tensile strength of 25,000 to 30,000 psi. will probably come out with a 65,000 psi. or higher tensile strength, depending upon the graphite content. With a low phosphorus content, the iron may have its elongation doubled or tripled.

It will probably be a year or more before cast irons of this type become available, but their advent will be welcomed by many users of cast irons.

During the year, the U. S. Naval Ordnance Lab. revealed details of a new permanent magnet material known as Permenorm 5000-Z. An iron-nickel alloy, Permenorm was first produced in Germany for use in huge rectifiers for the electrochemical industry. The Naval Lab. has spent considerable time in duplicating properties attained in the German alloy. That research has now been completed. In addition to being used in rectifiers, Permenorm 5000-Z is expected to find application in magnetic amplifiers to replace electronic tube amplifiers in guided missiles, etc.

Of interest to builders of cooking and heating stoves, melting pots, gas and oil burners, heat treating equipment and other products with similar service conditions is a new growth resistant cast rion. This iron was developed at Battelle Memorial Institute for Jackson Iron & Steel Co. Resistant to growth when alternately heated to 1700 F and cooled, the material is basically a high silicon iron. Minor amounts of copper and chromium are added to the ladle when pouring this iron to make it resist scaling at the higher temperatures.

An interesting bit of news came from the Central Foundry Div., General Motors Corp., when the revelation was made that this foundry is now producing 100% annealed soft gray iron castings. It is believed

that this is the first application of such magnitude to involve annealed castings. Benefits are reported as including tool life four times that normally attained in machining and freedom from hard spots.

Processing Developments

Too new to enable many details to be revealed is an unusual application of induction heating. R.F. heating is used for local annealing of steel for drawing. Critical areas of steel parts are annealed before pressworking. Areas so treated include those which must take severe forming such as small-radius fillets, unusually deep draws, or complicated shapes.

Still in the final stages of investigation is a new chromium impregnation process. The method is similar to pack carburizing except that a chromium-rich powder is used as the packing material. Steel to be treated is packed into ordinary carburizing boxes, heated to 1850 F and held at that temperature for a period which depends upon the desired penetration. Depths of from 0.0005 to 0.025 in. are said to be possible.

Developers of the process claim that it can be used with practically any type of steel at a cost comparable with that of carburizing. Parts which seem suited to the new treatment are those subject to corrosion, erosion and excessive wear.

Westinghouse Electric Corp. engineers have learned how to provide an oxide coating on electrical steels which will serve as insulation and also provide better paint adhesion. The thin, tightly adherent oxide film results when either high- or low-silicon steel laminations are subjected to a steam atmosphere at 500 C (932 F). The laminations are first heated to 212 F and then steam is admitted.

The blue oxide insulating coating is provided on parts for electric motors which are expected to undergo particularly severe service.

An interesting application in which the properties of two different materials were used to best advantage came to light recently. The lid of a new pressure cooker saucepan is made of Invar and stainless steel. The fact that Invar has 1/13 the thermal expansion of stainless steel causes the lids to bend and form a pressure tight seal when they are heated.

Nonferrous Metals

Although aluminum and magnesium have received considerable attention during the last few years, it is quite likely that investigation will continue, particularly in view of projected defense plans. Army and Air Force procurement agencies have signified their intention of pushing research towards stronger magnesium alloys for all types of equipment.

Whether as a result of armed forces requirements or not, two important new magnesium alloys were announced in the July issue of MATERIALS & METHODS by Dow Chemical Co. Both will find important use in aircraft.

Magnesium

First of the new magnesium compositions is ZK60 an extrusion alloy which contains 5.5 zinc and 0.50% zirconium. As extruded the alloy provides 49,000 psi. tensile strength. Aged, the same alloy develops a tensile strength of 53,000 psi. The material has good impact strength.

With this alloy a minimum ratio of 50 to 1 between the extrusion press chamber and the extruded form as well as close temperature control are necessary to provide maximum properties. The extruded forms of ZK60 are joined by riveting rather than welding.

ZK60 is expected to find wide use in such structural applications as aircraft wings and floor beams.

The second new magnesium alloy which is available in either cast or wrought form contains 5 cerium and 1.2% maganese. For casting, the cerium content is increased to 6%. The alloy is known as EM 51. The alloy is heat treated to attain maximum properties. The EM51 composition is said to be on a par with aluminum alloys in resistance to creep. It is weldable and, like most magnesium alloys, is highly machinable.

EM51 is intended for aircraft engine parts. The alloy is said to raise the working range of magnesium materials by as much as 300 F higher than present limits.

Even more important, from the standpoint of the greatest utility to all users of magnesium, are two processing and joining techniques recently perfected. Dow Chemical Co. is responsible for a plating process and a method of brazing magnesium.

Thus far, brazing is confined to the MI alloy. Joining is attained with magnesium-base filler alloys and chloride base fluxes. Brazing can be done by furnace, torch or flux dip methods. Induction and electric resistance methods are not yet used. With success attained in brazing this alloy, investigations are continuing to develop brazing alloys for other magnesium compositions.

The quick formation of hydroxide films on magnesium in aqueous baths has been the handicap to a successful method of plating magnesium with other metals. Plating is not essential to the use of magnesium, but there is a tendency to tarnish and spoil surface appearance. Therefore, plating is often desirable.

The Dow process is based on a preliminary immersion zinc coating step. After the zinc dip any commonly used plated coatings can be applied. The steps are as follows: Mechanical and chemical cleaning of the magnesium surface; zinc coating from a bath; electroplating.

Portable tools, costume jewelry and household appliances are among the items expected to be plated most generally.

This year, for the first time magnesium was used for aircraft skin surfaces other than control surfaces. The application was made on the Douglas-built Navy Skyrocket. The magnesium sheet was shaped by stretch forming.

Aluminum

Aside from the need to find additional materials for automotive use because of the steel shortage, there are practical reasons why aluminum should be used in these applications. Therefore, Reynolds Metals Co. announced two automotive aluminum sheets. A.S. #1 is offered as having the best combination of workability, strength and price. A.S. #2 is developed for deep drawing.

Better quality, reduced costs and a lowered reject rate with aluminum die casting are reported with a 2-chamber induction melting furnace introduced during the year. One chamber is used to melt the alloy being cast and the other to hold the molten alloy at casting temperature. The furnace, of course, is not restricted to aluminum and its alloys, but it does prove highly satisfactory in this application.

In aircraft use 75 ST aluminum alloy replaces steel on some landing gear struts. The aluminum is chromium plated by a process developed by Van der Horst Corp. of America. The aluminum part is coated with 0.002 in. of chromium. Preliminary tests indicate that the plated aluminum part will probably outlast steel on this application.

During 1948 aluminum became available in embossed sheet form. A sheet with raised patterns, the form of aluminum provides increased rigidity to the point where, in some instances, aluminum could replace steel thickness-for-thickness. The embossed sheets are practical for automobile running boards and pebble guards, clothes hampers, and many other parts and products.

Other interesting developments in aluminum include the making of forgings of 75S alloy for the aircraft industry in sizes considerably larger than previously possible; Alclad aluminum beer barrels, welded by the inert gas shielded arc process. A high purity aluminum liner is used over a base layer of strong aluminum alloy.

The General Electric Co. Research Laboratory announced development of a new aluminum alloy which has 2½ times the elastic strength and only 1/10th the true creep rate of the electrical conductivity grade of aluminum. At the same time the material has satisfactory conductivity. A trace of magnesium makes the difference.

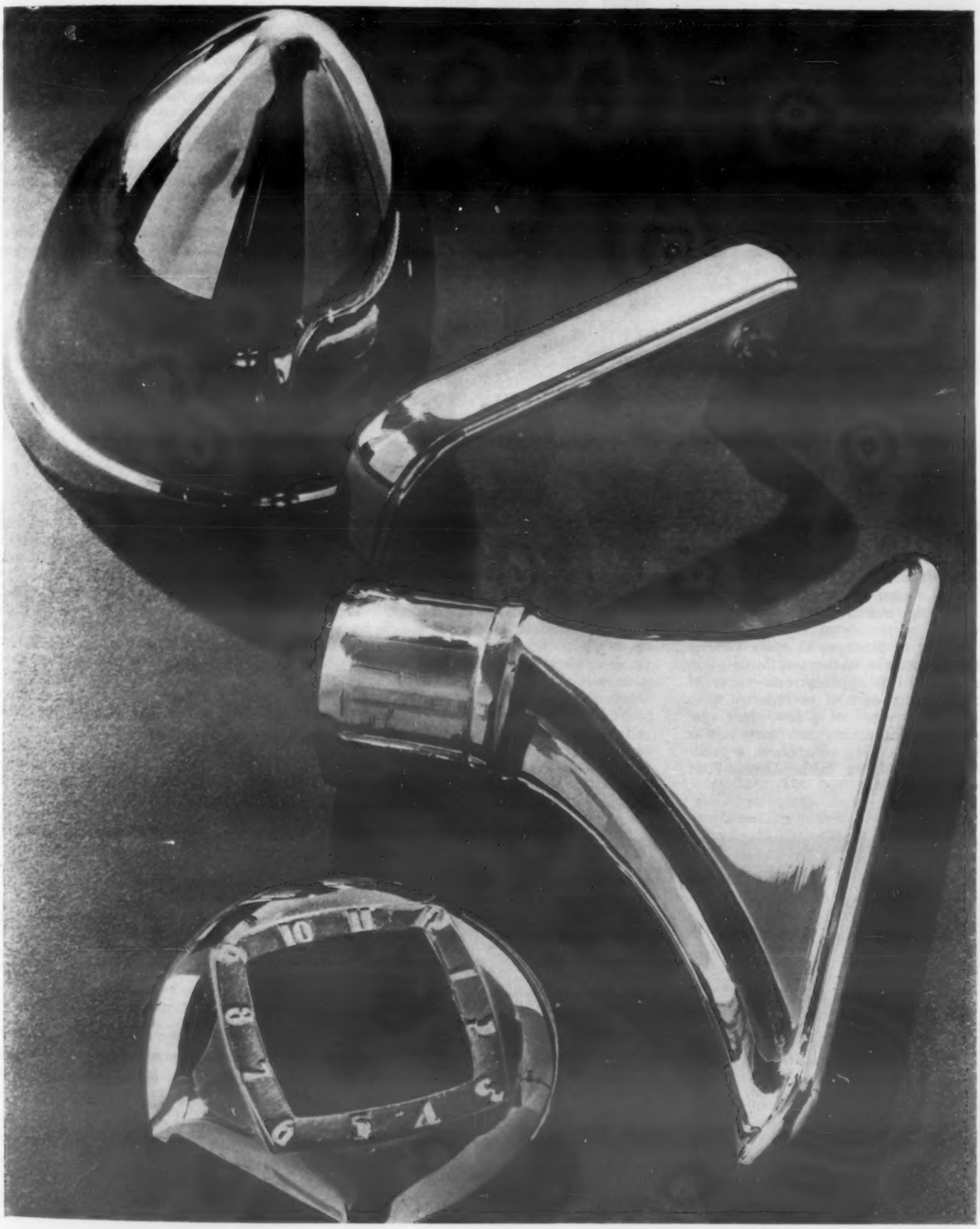
This development is expected to permit further development of large generators and as a further replacement for copper.

Copper - Base Alloys

During 1948 Fansteel Metallurgical Corp. announced five new copper-base alloys which offer a wide range of mechanical and electrical properties. These alloys range from those having moderate hardness values up to one alloy which has strength and hardness exceeding any other copper-base alloy. They offer the corrosion resistance of pure copper. With the superior alloy of this new group endurance resistance is almost equal to that of spring steel and provides a lighter weight versus strength ratio than the light metals.

One outstanding characteristic of several

Now that both aluminum and magnesium can be plated, their uses are expected to expand.



of these alloys is their resistance to annealing under service conditions involving heating and cooling. The alloys are available in several different forms, with all but the mildest alloy being available as castings.

Some uses for the alloys include soldering tips, parts for induction furnaces, electrical connectors and electrode holders.

Another development which came from Fansteel is Fasaloy 99, a new contact alloy. Fasaloy 99 has many of the desirable properties of silver as a contact material, plus a higher "no weld" current value. The material is suited to low operating pressures and high temperatures in high amperage circuits.

An aluminum bronze alloy has been developed by Ampco Metal, Inc., which is expected to find wide use as a material for drawing and forming dies. The alloy offers exceptional hardness, high compressive strength and good wear resistance. One report based on production of a stainless steel part shows that 77,000 parts were produced on dies of the new alloy before redressing was necessary. This compares with 3,000 pieces on conventional steel dies.

The cupro-nickel alloys have been supplemented with a new 90 copper, 10% nickel alloy. This material is expected to be widely applied in both the industrial and marine fields since it is an alloy which offers good corrosion resistance but which is also moderately priced.

Other Nonferrous Metals

Of greatest interest in the nonferrous metal field is the rapidly accelerating investigation into the properties and application of titanium as well as the development of titanium-base alloys. Many companies have entered into the production of metallic titanium, and all of the armed services are examining the possibilities of its use in aircraft, marine equipment and armament.

It is neither safe nor certain to cite titanium's properties yet, since different results are obtained through different methods of production of the wrought metal. Its apparent properties can be summed up by saying that titanium is light, strong, durable and corrosion resistant.

A new resistance alloy became available last year which is ideally suited to such applications as wire-wound resistors for use on aircraft equipment. The alloy is known as Evanohm and was developed by Wilbur B. Driver Co. Evanohm is a modification of the standard 80 nickel, 20% chromium resistance alloy, its composition being 20 chromium, 75 nickel, 2.5 aluminum and 2.5% copper.

The resistance alloy is said to offer high electrical resistance with little change in resistance with temperature variations. The alloy is susceptible to heat treatments designed to place its resistance properties within very narrow limits, over a rather wide range.

Germanium, a material which is classed as a semi-conductor of electricity, was revealed by Bell Telephone Laboratories as having unique properties in electronic applications. The element is the heart of a simple device, known as a Transitor, which performs nearly all of the functions of a vacuum tube. Anticipated uses of the Transitor include amplification and oscillation in television and other electronic circuits.

Nonmetallic Materials

It seems natural that plastics would attract the major attention in the field of nonmetallic materials during 1948. They did. While more plastics than ever were being used, most manufacturers of the basic molding materials were busy improving the properties of those materials.

As a result of attempts to make plastics suited for certain rather difficult—but seemingly logical applications—several plastics were first offered to industry with properties undreamed of a few years ago.

One of the interesting new materials is Plaskon alkyd molding compound, a product of Plaskon Div., Libbey-Owens-Ford Glass Co. It is a mineral-filled thermosetting plastic with a remarkably short curing time. Filler materials now used are clay and asbestos.

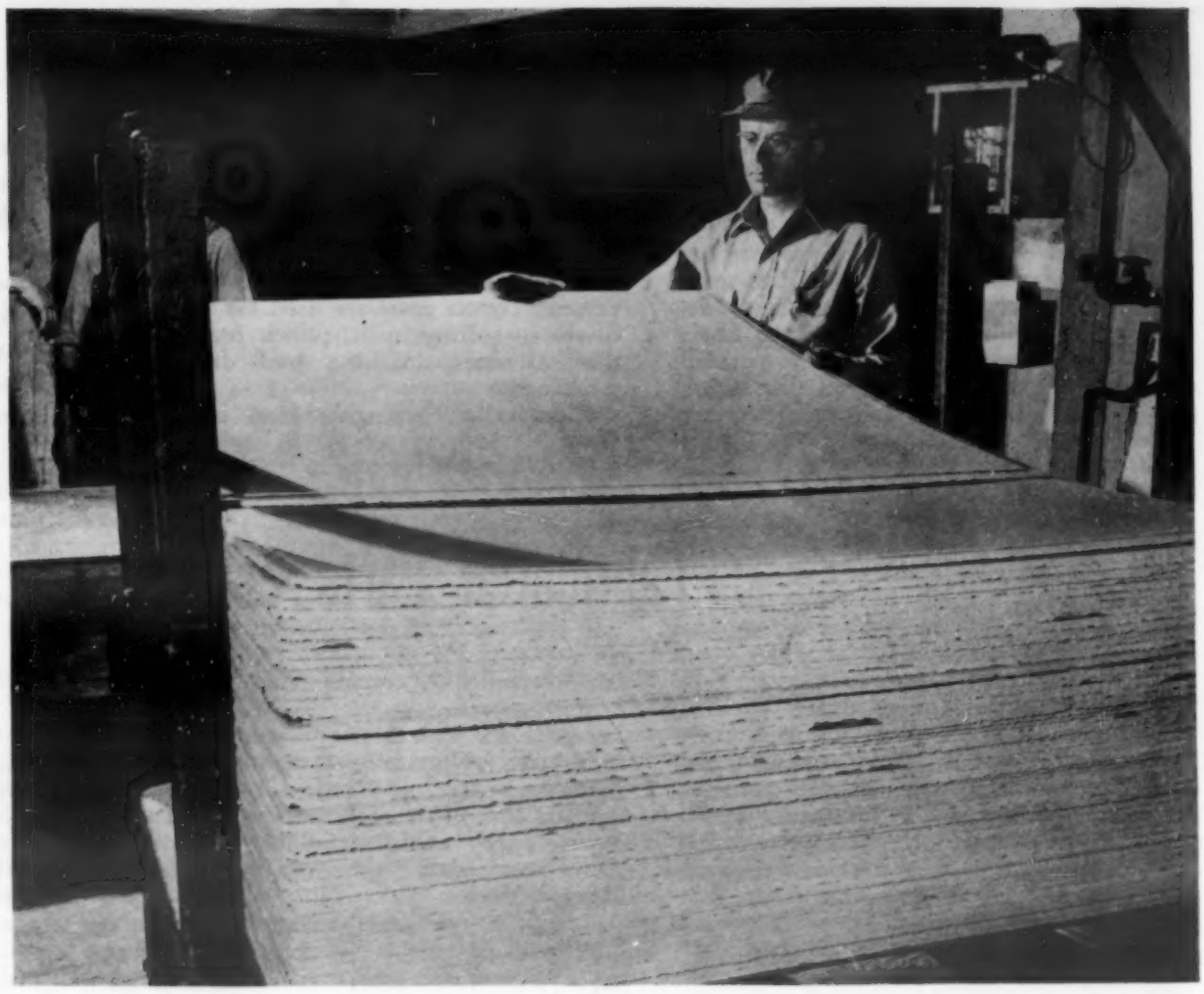
Perhaps of equal importance to the low curing time—usually less than 25 sec.—are the materials' properties which include good electrical properties, high heat resistance, low moisture absorption and good dimensional stability. Although the room temperature tensile, flexural and compressive strengths are somewhat less than cellulose-filled thermosetting plastics, moldings of the new Plaskon material retain a high percentage of strength at 300 to 350 F for extended periods. Parts molded of the new compound are resistant to all common organic solvents and to strong and weak acids.

Also boasting a shortened molding cycle is a new urea-formaldehyde molding compound produced by American Cyanamid Co.'s Plastic Dept. It is called Beettle Med. (FC)—the FC indicating fast cure. Cure time is about half that required for the standard urea plastic. Much of the increase in curing time is attainable by careful control over the necessary molding steps. The material has low mold shrinkage, good finish and a high degree of stability.

Another American Cyanamid development is Melmac 404, which is a thermosetting resin with high translucency. The optical quality is combined with good strength and good resistance to impact.

Polystyrene P-8 is a new product of the Chemical Div., Koppers Co., Inc. The material is a high heat resistant, low shrinkage one which offers interesting properties. It can be molded into glass-clear products as well as colored; it molds as easily as regular grades of polystyrene; when pro-

Said to be the largest one-piece molded plastics item, this 28-ft. personnel boat has been completed for the U. S. Navy. The 2600-lb. hull, of polyester resin with glass fiber mats as the laminating material, is low-pressure molded. Savings in hull construction costs approximate 90%. Hull maintenance is eliminated, and the dangers of bacteriological attack greatly reduced. The first order for these craft has been placed with Winner Manufacturing Co. and Marco Chemicals, Inc.



Sawdust, woodchips, and Monsanto's Resinox are combined under 300 to 350 F heat and 200-lb. pressure to produce millwork paneling by the Curtis Companies, Inc. of Clinton, Iowa. The phenolic resin binder increases the dimensional stability and water resistance of the natural wood fibers, and results in a smooth, grain-free surface for the molded product. The "boards" can be sawed, turned, or otherwise handled like wood, and are not subject to splitting. The material is claimed to be at least as strong as wood in its weakest direction.

duced in colors, the material shows high resistance to fading. P-8 is not intended to replace other grades of polystyrene, but is expected to extend the range of application. Most heat resistant materials of this type are sold at premium prices, but P-8 is to be sold at prices normal for other materials of the same general group.

Kel-F, a plastics material with a high degree of stability over a wide temperature range, good high temperature properties and inertness to chemical attack is being produced by the M. W. Kellog Co. The material can be formed by compression, transfer and injection molding, and by extrusion into sheets, films, tubing, rod and shaped pieces. Another unusual feature of this compound is that it can be provided with varied properties through heat treatment. It can be made relatively soft and resilient or harder and less yielding, according to the temperature at which it is treated.

Extensive tests show that Kel-F has satisfactory properties at temperatures between −320 F and 390 F. It acts as both a heat and electrical insulator, and can be punched and machined to close tolerances.

A wide range of uses of Kel-F are predicted in applications where the material is likely to encounter dampness, relatively high temperatures and corrosive media. These uses would include pump and valve packings, gages, laboratory tubing and pressure safety valves.

Available in film form and as sheeting is Ultron, a new vinyl formulation by the Plastics Div., Monsanto Chemical Co. The material has higher heat resistance than most vinyls as well as better resistance to chemical attack and abrasion. This combination of properties indicates that in the resin form Ultron will find considerable use as an electrical resistant wire coating material.

A treatment made available to industry in general early in 1948 made possible the greater use of clear polystyrene sheet. This material in its natural state is rather easily marred by scratches. Furthermore, the material resists polishing to remove such scratches. In addition, many common cleaning agents, gasoline and oil affect the surface of polystyrene. The treatment referred to is known as Logoquant and overcomes the handicaps which limited the use of polystyrene in places where surface appearance was important.

The material is added to the polystyrene surface by means of dipping or spraying, after which fusion is attained through a low temperature heating cycle. Logoquant treating provides a hard surface that can be polished at a total cost that is less than that of more expensive plastics which are suited to the same applications. The process was developed for Nash-Kelvinator Corp. and is licensed through the Bee Chemical Co.

Plastics Applications

Extruded vinyl plastics which have now taken away 30% of the garden hose business from rubber are expected to raise this figure to 50% in 1949. This is only one important use of extruded plastics, the chief use being as coatings for electrical wires. In addition, extruded sheet and forms are used as flexible gaskets, bumpers on household appliances, sealing strips and spline in metal window glass frames.

Among interesting plastics applications introduced during 1948 was the use of nylon for wheel bearings. While the first product on which these bearings were applied was a baby buggy, the use is expected to extend to food mixers, shavers and similar electrical equipment. Nylon bearings outwear steel and, as an added advantage, these bearings require no lubrication.

Polystyrene wafers have replaced ceramics on some printed circuit applications. In such cases, silver is printed directly upon the plastic shape. The advantage over ceramics in this application lies in the fact that the plastics part is lighter in weight and that it can be made thinner, thus using less space in the finished product.

One of the largest, if not the largest product to be built of plastics is a 2600-lb. boat hull. The hull is 28 ft. long and is made of glass matts impregnated with polyester resin and low-pressure molded. The hull is intended for Navy use as a launch.

Plastic resin is used in a new type abrasive cut-off wheel. Cloth is impregnated with a resin-abrasive mixture. The combination of materials results in a wheel which will not shatter even when struck by hard objects while the wheel is travelling at high speed.

Other Nonmetallic Materials

Several plastics-synthetic rubber compounds have been developed during the last year to offer properties not to be found in either group of materials alone.

One such material is Lactoprene, which is basically a synthetic rubber. It was developed by B. F. Goodrich Chemical Co. and is described as a polyacrylic ester. The material withstands dry heat up to 400 F for several hours without adverse effect.

Lactoprene is resistant to oils, ozone and sunlight, and has good flex life. Its uses will include high temperature gaskets, insulated wire and brake linings.

Phenolic resin impregnated cotton has been used for mechanical parts for some time, but now a method has been developed to use bolts of raw cotton fibers for such parts as gears. The only material added to the cotton is mineral oil, which aids forming. The gears so produced are given additional strength through the use of steel shrouds and studs.

Gears made of cotton offer high strength, resilience greater than that of steel, toughness and quiet operation. Gears in use withstand a static stress of 8,000 psi. At present, cotton gears are used for table roll drives in rolling mills, punch presses, textile machines, machine tool drive gear trains, etc.

Electrically conductive glass is on the threshold of being a reality. At least two glass manufacturers have been working on such a project for some time. An obvious use is in automotive, railroad and aircraft windshields, but more important uses technically are in the offing. Such uses would include the making of tanks to hold liquids at temperatures somewhat above room temperature.

Fabricated Parts and Forms

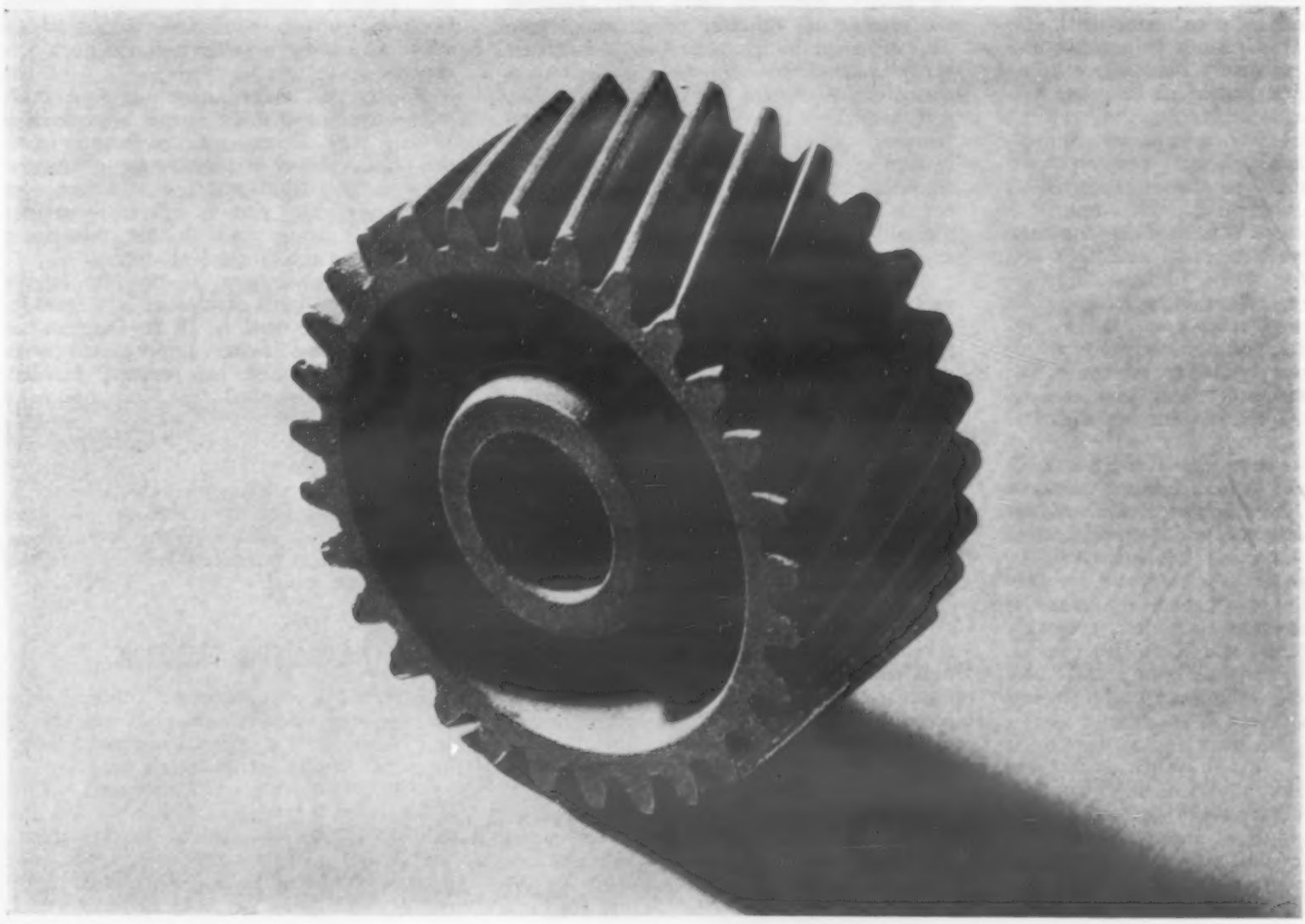
The year 1948 saw a much greater recognition of the value of accepting the newer methods of producing parts of complicated shape or made of difficult-to-handle alloys. While such processes as powder metal parts production are still looked upon by some people as more or less glamorous methods which could not compete except in unusual cases, this opinion is being proved false daily.

There are innumerable examples of powder metal methods being chosen on a competitive basis for parts that could readily be made in several other ways. The same holds true of precision investment casting. Likewise, older production methods are finding new fields of activity when manufacturers seek means of holding down costs in the face of steady increases in wages and material costs.

Certainly one of the most interesting developments of the past year is the solution of problems involved in producing helical gears by powder metal methods. Such a part has been a plum which dangles before the noses of parts producers for years. While some details of the method by which these gears are produced are retained as trade secrets, the crux of the problem was production of a die which would permit withdrawal of the parts.

The successful helical gears made from powders are now made of iron, although brass and copper powders could also be used. Gears now made are used to drive food mixers, toy electric trains and similar products. The iron powder gears are said to have equivalent wear resistance to parts made of heat treated SAE 1040 steel. The

In the field of powder metallurgy, one of the most interesting developments of 1948 was the production of helical gears by this method.



cost of the powder metal gear is much less than those previously used; in fact, the finished gear is said to be equal in cost to the gear blank alone. As an additional talking point, the powder metal gear is self lubricating.

A development described more completely in the Iron and Steel section of this review merits passing mention here. It is perfection of a method by United States Pipe & Foundry Co. of a method for making tubular castings of most ferrous and some nonferrous metals by centrifugal methods. The process is useful in providing combination materials in which the tubular shell is of one material and the lining of another. The process is best suited to high alloy tubes, since it cannot compete on a price basis with thin-walled seamless or welded tubing. Tubing so produced can be 3 to 24 in. O.D., 8 ft. long, and have wall thicknesses between 3/8 and 2 in.

Again referring to an earlier section of this review, we recall the development of nodular cast irons. These irons, due primarily to the spheroidal form of graphite in the cast shapes, have properties about twice as great as cast irons of the same conditions. British and United States techniques vary somewhat, but the final results are close. Complete details of the production of these super strong castings is expected sometime during 1949.

Another development in the field of tubing is the announcement by International Nickel Co. that its Huntington, W. Va., works can now produce extruded seamless Monel, Inconel and other nickel alloy tubing in diameters up to 9½ in. Prior to the war, 5-in. extruded tubing was the limit. Among uses for such large tubing are table rolls for paper making machinery, sleeves for large shafts, stems for large valves, cylinders, and many others in diverse industries.

Aluminum tubing is now being used to carry crude oil in pipe lines. Corrosion damage is much less under some soil conditions than with steel tubes. Sections of aluminum tubing are welding in the field by means of portable welding equipment.

General Electric Co. has announced two developments involving permanent magnets which seem of general interest. A new method of sintering Alnico 5, a permanent magnet material, permits the design of intricate shapes with higher energy than previously was possible. The process provides for economical production of small parts with smooth surfaces and close dimensional tolerances. The parts are also said to be finer grained and less brittle than formerly.

The second permanent magnet development concerns an unique application. Cunico permanent magnets support all weight of an electric meter's disk and shaft. By performing this task, the need for jewels is eliminated and meter maintenance all but done away with. Two cylindrical permanent magnets are placed one within the other. The outer magnet is fixed to the meter frame and the inner to the disk shaft. The magnets are magnetized axially with opposite polarities. The resultant field supports the rotating parts with a definite small downward displacement.

With a revival of armament programs in the United States came a new interest in high alloy steel castings, including those made of stainless steel. Under this program, the Lebanon Steel Foundry, Lebanon, Pa., obtained U. S. rights to the British Firth-Vickers method of centrifugally casting steels in permanent molds.

This casting method and that developed and used by Cooper Alloy Foundry, Hillside, N. J., are expected to be used for producing aircraft engine parts from alloys which are difficult or impossible to forge.

For years castings made of the light alloys have been desirable for use in applications involving air and liquid pressures. However, porosity which often plagues castings of these metals caused high rejection rates. In the past several types of sealant treatments have been developed to make such castings usable. Increased attention was paid to this problem during 1948, with the result that about a half dozen new sealants were developed. Most of the sealants withstand moderately high temperatures and pressures.

There has been a trend towards larger die castings for several years. This trend continued during 1948. Kux Machine Co. announced a standard machine capable of producing zinc die casting up to 30 lb. and aluminum parts up to 10 lb. The machine operates at 3 to 4 cycles per min. with zinc and about 2 cycles per min. with aluminum. The machine must be converted for use with the materials, using a gooseneck plunger mechanism for zinc and the cold chamber hand ladling method for aluminum.

Westfield Manufacturing Corp. have pioneered in large die castings, particularly in aluminum. In the past this company manufactured machines for its own use, but now offers similar machines for sale. These are the type machines which produced die cast aluminum engines for Jack & Heintz shortly after the war.

Welding and Joining

Welding, which has been gaining in importance over the past decade, continued to advance during 1948 through several important developments. The same holds true for brazing and other joining methods.

Resistance welding is continuing to gain importance as a joining method. More than five times the amount of resistance welding capacity is in use today than was available in 1939. Every month sees improvements in controls, electrodes and machine efficiency.

The problem of joining hard-to-weld metals by means of welding appears to be nearer to solution through the use of low hydrogen coatings for arc welding electrodes. Electrodes of this class are available which will deposit welds free of cracks and porosity. Among the steels in the problem class are high carbon steels (0.4% carbon and higher), sulfur bearing free machining steels, high tensile steels of high hardenability, and weldments where high impact strengths are desired.

Late in the year a gas shielded arc welding method was introduced for joining heavy sections of aluminum and aluminum alloys. Welding is accomplished by a continuously fed consumable wire which feeds at speeds of from 100 to 300 in. per min. The wire is fed through the barrel of a welding gun and power is supplied from standard d.c. welding generators. Gas is supplied through the gem's nozzle. Both gas and wire are started by trigger control.

From England we learned of an interesting method of joining aluminum, aluminum alloys and copper. The method is known as cold welding, and while satisfactory for aluminum alloys, does not provide sufficient strength for joining other metals. Alloys of aluminum to be joined are those with a silicon or manganese content of 3% or less. Heat treatable alloys are joined in the soft condition.

In cold welding no heat is applied, welding being accomplished by using pressure applied over a comparatively narrow strip. Absolutely clean surfaces are required. For this reason, power driven wire brushes are desirable, at least as a final cleaning method. Straight seam welds, sealing tube ends and ring welds are among the types of joining being done by cold welding. Greatest use of the process to this point has been in tube making.

Half hard commercially pure aluminum work hardens to an ultimate tensile strength of 22,000 psi.

The increased use of aluminum in electrical goods which continued through 1948 demanded new processing methods, particularly for such jobs as joining copper ends to aluminum coils. One method evolved is a butt welding procedure which results in an aluminum-copper joint in which either no alloy or a very slight alloy was formed. In the butt welding method for joining aluminum and copper, developed by General Electric Co., the materials are heated to the point of melting at their ends and then forced together. The joints formed by the method are approximately equal in strength to aluminum. Caution is required in the method to prevent formation of a copper-aluminum eutectic alloy which would have a low melting point.

Another interesting welding development is inert-gas-shielded spot welding. This method combines the features of resistance spot welding and metal arc plug welding. This fusion spot welding process can be used on ferrous materials which are free from heavy oxide coatings.

The ability of welding to do emergency jobs has helped spread its influence. Here welding was used to make gas pipe line fittings when the type of cast iron fittings required could not be obtained. Fittings ranged from 8 to 50 in. in dia.

The use of submerged arc- or hidden arc-welding has been extended greatly since development by Lincoln Electric Co. of equipment for semi-automatic welding. Feeding can be done by hand and thus a greater variety of work can be handled, both as to size and shape.

In addition, this type of welding can now be made to follow any outline by means of a strip templet. This type of equipment operates on much the same principle as automatic flame cutting to shape.

Fusion Engineering Co., Cleveland, revealed details of alloys used in paste form to produce metal joints at temperatures lower than normal. The alloys melt at temperatures ranging between 300 and 1800 F. They are applied to the joint area by brush, dipping, roller or pressure gun. Heating is done without atmospheres and no toxic fumes result from the melting.

In addition to requiring less heat than many joining processes, this method generally requires less alloy to produce a satisfactory joint than with most other methods. The latter fact is due to the ability to make joints without clearance between the parts.

Alloys are available to join aluminum, stainless steel, carbon and alloy steels, copper, silver, brass, tin, die casting alloys and carbides. Dissimilar parts, as to form, can be joined readily.

In the past, hard surfacing has largely been a hand welding operation. Now, however, the hard surfacing of parts can be done by automatic arc welding since the Stoody Co. has developed eight alloy rods for automatic equipment. With this development, production speeds are now possible for hard surfacing.

Brazing

The greatest development in brazing, at least as far as future possibilities are concerned, is the announcement that methods have been perfected for brazing magnesium. At present, brazing is possible only with the M1 magnesium alloy. To braze magnesium, magnesium-base filler alloys and chloride base fluxes are employed. Brazing is done by furnace, torch or flux dip methods. As yet techniques for induction and electric resistance brazing methods have not been perfected.

Pleased with the success of brazing this one alloy, Dow Chemical Co., which developed the process, is now working on other brazing alloys in the hope that brazing can be extended to several more magnesium alloys.

Vacuum brazing is now being used to join large components. Recently a high vacuum brazing furnace was designed and built for the Research Div. of Collins Radio Co. In the furnace, brazing takes place at pressures less than one micron (1/760,000th of normal atmospheric pressure). The almost total absence of air virtually eliminates oxidization during brazing. An immediate use of the furnace is in manufacturing components of large power tubes designed to generate high wattage continuous power at microwave frequencies.

Other Joining Methods

From the West coast comes word of a self-soldering tape which joins parts without the use of a soldering torch or iron. The tape is composed of a ribbon of lead-tin solder attached to a ribbon of vinyl plastic in which aluminum type heating fuels are dispersed. The tape is put in or around the parts to be joined, the tape ignited and soldering proceeds. This soldering method is said to be usable in joining copper, brass, tin, iron, zinc and some other metals.

A new adhesive bonding method for metal to metal bonds comes from the Minnesota Mining & Mfg. Co. The vehicle looks similar to cellophane and comes in rolls, although it is 100% adhesive. The adhesive action comes through a combination of heat and pressure. The adhesive is placed between the parts to be joined, then the assembly is heated to between 300 and 500 F for 5 to 60 min. and pressure between 25 and 100 psi. is applied.

Tests have shown shear strengths of 3500 psi. in joining 0.064-in. Alclad aluminum. The adhesive joints are inert to water, oils and most solvents.

The mechanical fastening of aluminum parts is now improved through development of a complete line of bolts, nuts, rivets, screws and nails all made of aluminum.

Heat Treating

Progress in heat treating continued its steady advance during 1948. Efforts of steel makers, steel users and the makers of heat treating equipment, supplies and accessories were directed towards obtaining certain, positive results.

One of the most interesting developments of the year was a method of through carburizing. The skin recovery of carbon which was used extensively during the war, and since, has now been extended so as to add carbon all the way through a ⅛-in. thickness of steel.

The entire process, which was described in detail in the June 1948 MATERIALS & METHODS, is essentially this:

A low carbon or low alloy steel is chosen for a part because of easier fabrication, but a higher carbon content is needed throughout because of service requirements. After machining, the part is placed in a furnace having an atmosphere with a high carbon potential. The carbon content of the atmosphere is kept high at the start and then decreased during a diffusing cycle. At the start, carbon is concentrated near the surface and then driven in. While the process is not difficult, careful control is required throughout the entire cycle.

Buick Div. of General Motors Corp. is using the process on a clutch spring. The material used is a low alloy steel with 0.15% carbon. After the processing, the steel's carbon content is built up to between 0.45 and 0.50% throughout. It takes from 1½ to 2 times as long to through carburize as would be needed to build up a hardenable case to the same depth. According to Buick officials, the process not only results in a better product, but it also reduces the cost per piece of the parts.

Low-pressure stress relieving came in for considerable attention during 1948. The methods are used on large welded structures such as ship and pressure vessels. The temperatures involved are about 350 F, or approximately 250 F above the temperature at the point of stress.

Low-pressure stress relieving is achieved by use of blowpipes which direct flames parallel to and on each side of the weld. This heating method provides for a moving zone of heat. The heated areas consist of zone on either side of the weld, the centerlines of which are about 5 in. from the centerline of the weld.

Westinghouse Electric Corp. has perfected a method of simultaneously furnace brazing and bright hardening air hardening tool steels. The work is done in an Ammogas atmosphere furnace. In jobs of this type various silver brazing alloys are used with little clearance between the parts. Strength of parts so joined is said to be equal to copper brazing.

Shortly before the end of the year, news came of a new chromium impregnation process that is said to be less expensive than gas chromizing and applicable to a wider range of steels.

The method is similar to pack carburizing except that a chromium-rich powder is used as the packing material. The steel is packed in ordinary carburizing boxes and heated to 1850 F and held there for varying periods of time, depending upon the thickness of impregnation desired. Depths of from 0.0005 to 0.025 in. are possible.

The process is expected to find application where corrosion by itself or in company with erosion is anticipated and where greater wear resistance is desired. This method of chromium impregnation is said to be applicable to any kind of steel. The cost is estimated as about equal to that of pack carburizing.

A case hardening paste known as Carburit was announced during 1948 for use in selective hardening of steel. The paste is used to cover the area to be treated and the part heated to 1700 F. A 0.010-in. case results when the work is held at the 1700 F temperature for 5 to 7 min. By holding the parts at temperature for 25 to 30 min., a 0.040-in. case is obtained.

After the initial heating period, the work is cooled and then reheated to 1500 F, the paste knocked off and the parts quenched. Hardnesses achieved are said to be comparable to those obtained by other methods of case hardening.

Another new paste is used to isolate parts of a workpiece to keep them soft while the remainder is hardened. The paste is intended to be used in place of copper plating or other isolating methods. Isopac, as the paste is known, prevents penetration of carbon gas and insulates the part to prevent rapid cooling. The paste can easily be removed after the work is quenched. This method of insulating is said to work with any carburizing method—furnace, atmosphere or salt bath.

Heat treating is now being used in conjunction with parts produced by precision investment casting to achieve a variety of properties with a minimum number of alloys.

Finishing and Coating

Industry in general must still be searching for better finishing methods and coating materials, judging by the steady improvements made in the field. From this viewpoint, 1948 was no exception.

For the past few years, rumors have circulated about a process for enameling aluminum. Details were kept secret until late in the year when the Du Pont Co. announced that it had successfully developed such enamels for some aluminum alloys. The alloys are 61-S wrought alloy and 43 casting alloy. The development comes after six years of research in the Electrochemicals Dept. of the company.

The new enamel is vitreous. It is fired on aluminum strips, sheets and castings in furnaces similar to those used for porcelain enameling of steel. Aluminum treated in this manner is already in use for storefront panels and advertising signs. Enameled aluminum is expected to be used for sanitary ware, washing machines and outdoor furniture, among other products.

Since the new enamels contain a high percentage of lead, they are unsatisfactory for products which come in contact with food. However, tests show that resistance of the enamels to acids and alkalis is comparable to that of enamel on steel.

The aluminum enamels are fired at a temperature several hundred degrees below that used in enameling steel, a factor in the original cost and operation of the process. On the other hand, enamels are only being produced on a small scale, at present, making the total cost of enameling aluminum somewhat higher than the application of porcelain on steel.

Users and prospective users of light metals displayed considerable interest over announcement during 1948 that a method had been developed for plating on magnesium. Magnesium is inclined to tarnish slightly, so plating is desirable to enhance appearance.

Plating of magnesium is based on a preliminary immersion zinc coating step. After the zinc dip, any commonly used plated coating can be applied. Portable tools, costume jewelry and household appliances are among the products which should benefit from plating.

In the past, attempts to electroplate magnesium have been hampered by the quick formation of a hydroxide film on the magnesium surface when immersed in aqueous baths. The process, as perfected by Dow Chemical Co., involves the following steps: chemical and mechanical cleaning; zinc coating in a special bath; and, electroplating.

Akin to plating is a new process of nickel coating by chemical means. The plating action is a result of chemical displacement from a hot nickel chloride, boric acid solution. Through this process, deposits up to 30 millionths of an in. (0.75 micron) thick are possible. As deposited, the coating is porous. However, heating to between 1200 and 1400 F makes the deposit compact and adherent. Heating actually causes diffusion so the resultant product is really a nickel-iron alloy coating on steel. When and if rust forms it is as a light oxide film. The coating serves as a good basis for any other coatings.

A new low-temperature porcelain type coating for metals is in the final stages of development. The coating has a hardness value ranging between porcelain and organic finishes. The coating is cured at 350 F and withstands 1000 F temperatures. It withstands impact and thermal shock, the latter repeatedly even up to the full 1000 F temperature. The coating can be applied to light gage metal without warping, and can be applied to aluminum, magnesium, glass, ceramic ware, asbestos shingles and many other materials.

The low temperature coating is available in many colors. Typical uses include the coating of gas or electric heaters, muffles, transformer cases, metal shingles, etc.

A new dip coating to produce corrosion-resisting conversion coatings on hot dipped zinc, plated zinc and zinc die cast parts has been developed by United Chromium, Inc. The dip compound, depending upon the amount of dilution, produces one of the following finishes: (1) on zinc plate, a clear bright finish that looks like chromium, or an olive drab finish; (2) on zinc die castings, a clear bluish finish, or an olive drab; (3) on hot dipped zinc, a bright spangled finish or an olive drab one; (4) on all zinc, a coating which serves as a good base for paint, lacquer or enamel. The dip process is especially suited to parts too small or complex to plate economically.

Something new in the way of finishing comes from Westinghouse Electric Corp. That company has found that by causing the formation of a thin, tightly adherent oxide film on electrical steel, good insulating properties are achieved on the steel surface. In addition, the oxide film provides good paint adherence. In carrying out the process, either high or low silicon content steel laminations are exposed to a steam atmosphere at a temperature of 500 C. The steel is first heated to 212 F and then steam is admitted to the heating area. The first application of material so treated is on electrical equipment subjected to severe dampness conditions.

Cleaning

One of the most interesting cleaning developments of the year was the discovery that electrochemical cleaning could be used successfully on huge castings. At the G. E. Schenectady Works, a 18,300-lb. casting for a lower turbine shell was so cleaned. The method was selected since it was felt that by so cleaning the manufacturers could be assured of complete freedom from embedded and fused sand.

To do this job, 19,000 lb. of flaked caustic soda was charged into a preheated tank. An additional 11,000 lb. was added during the first 24-hr. melting period. The material was melted at 575 F.

The casting, the composition of which was 0.20 carbon, 0.76 manganese, 0.37 silicon and 1.10% molybdenum, was preheated to 750 F before being placed in the bath. For the oxidizing cycle, 2200 amp. current was applied for 3 min., for reducing, the polarity was reversed and 4,000 amp. at 6 to 7 v. applied for about 2 hr. The casting was lifted from the bath, drained, flushed and inspected, after which it was treated for an additional 2½ hr.

A modified form of impact blasting using an abrasive suspended in a liquid under pressure is the basis of the Hydro-Finish method developed by the Pangborn Corp. In cleaning parts tolerances as close as 0.0001 in. can be held. With fine non-metallic abrasives, no breakdown of sharp edges is experienced. The process is used for deburring, descaling and preparing metal parts for plating. In addition to the cleaning effect, Hydro-Finish has some peening effect on surfaces cleaned.

In some circumstances blast cleaning is replacing pickling on steel parts. Generally chilled iron pellets are shot against the parts, without the use of air to break up and remove the scale. The process, as developed by American Wheelabrator & Equipment Corp., is most efficient when the dirt to be removed is hard and dry. Care in the selection of the pellets is necessary when cleaning parts other than iron and steel, to avoid danger of iron contamination.

In addition to being used on semi-finished parts, the process is useful in cleaning sheet and strip before cold treating and helps prepare surfaces for adhesive bonding. Where applicable, the process has the advantage over pickling of presenting no waste disposal problem or creating a health hazard.

Tumbling has been found to be superior to buffing on some types of plastics parts. Particularly good results are obtained with parts of clear acrylic. The parts are opaque when they enter the tumbling barrel and come out transparent, glossy and smooth.

Shaping and Forming

In forging, drawing, spinning and other methods of producing metal forms, there seems to be a continuing trend toward larger parts having greater accuracy. Forging presses and hammers as well as hydraulic and mechanical presses for deep drawn parts are being made with capacities that were unheard of a few years ago.

As an example, the National Machine Co. designed and built a 1,000,000-lb. mechanical forging press for installation in the Wyman-Gordon Products Co. plant at Harvey, Ill. Intended primarily for producing automotive crankshaft forgings, the press is capable of 40 strokes per min.

Also developed by National Machinery Co. is a process, used in connection with their forging presses, known as Maxi-rolling. Forging billets are preformed in rolls on the press, before actual forging begins. By using this method scrap losses are said to be reduced, die life extended and higher production rates achieved.

In steel drawing, a new development incorporates the use of local annealing to permit greater draws than would be possible normally. Critical areas of the steel are annealed by means of high frequency induction heating before pressworking. Such areas would be those subject to severe forming such as small-radius fillets, unusually deep draws or complicated shapes. The process is so new that comprehensive results are not yet available, although early experiences are promising.

Now that magnesium sheet is being used for the outer skin surfaces of aircraft, techniques are being perfected for stretch forming that material. Since magnesium sheet is formed while hot, the methods normally employed for other metals do not prove satisfactory. At Glenn L. Martin Co. a method was devised whereby the sheet is formed over a die covered with glass fiber blankets. Among other advantages, the use of the glass fiber prevents the loss of heat from the sheet to the die. No grease is needed to lubricate the sheet for forming, therefore no cleaning problem is involved.

Ford Motor Co., early in the year, revealed details of a method it employed to make trial runs of stamped and drawn shapes. The process the company uses involves the use of a variation of Wood's metal. At room temperature the alloy is softer than lead, thus making easier the production of dies. When the die is shaped it is immersed in liquid nitrogen. The extremely low temperature to which the alloy is reduced by the nitrogen makes it sufficiently hard to withstand forming pressures necessary to make a dozen or more parts.

By using this process, Ford can have dies for trial stampings ready in 24 to 48 hr., as opposed to weeks necessary for steel dies. The soft alloy dies withstand pressures up to 25,000 psi. when cooled, and can produce approximately 250 stampings before it becomes necessary to remake them.

Materials Engineering File Facts

NUMBER 171
January, 1949

Methods and Types of Cleaners for Various Metals

No attempt has been made here to include all known cleaners for metals. Instead, the aim is to provide a general list of types of cleaners and their application to some of the most common metals and metal forms. For final selection of a cleaner for a specific application, consult a reliable producer of cleaning compounds.

Method of Cleaning	Type of Cleaner	Steel, Heat Treated	Steel Stampings and Finished Parts	Cast Iron	Zinc-Base Die Castings	Aluminum	Copper	Brass	Bonderite Cleaning	Remarks
Power Washers	Soda ash	X	X	X	—	—	X	X	—	—
	Trisodium phosphate	X	X	X	—	—	X	X	—	—
	Tetrasodium pyrophosphate	X	X	X	X	X	X	X	—	—
	Light-duty alkali	X	X	X	—	X	X	X	X	—
	Medium-duty alkali	X	X	X	—	X	X	X	X	—
	Metasilicate	X	X	X	X	X	X	X	—	—
	Sesquisilicate	X	X	X	—	—	X	X	—	—
	Rag or laundry cleaner	X	X	X	—	—	X	X	—	—
	Medium-duty (nonetching) alkali	—	X	X	X	X	X	X	—	See Note 3
	Orthosilicate	X	X	X	—	—	X	X	X	—
	Solubilized solvent, nonprotective type	—	—	—	—	—	—	—	X	—
	Solubilized solvent (used with kerosene)	—	X	X	X	X	X	X	—	Can be used as a dip. Rinse with clear water.
	Solubilized solvent, protective type (used with kerosene)	—	X	X	—	—	—	—	—	—

(Continued on page 91)

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Materials Engineering File Facts

NUMBER 171 (Continued)

METHODS AND TYPES OF CLEANERS FOR VARIOUS METALS

Method of Cleaning	Type of Cleaner	Steel, Heat Treated	Steel Stampings and Finished Parts	Cast Iron	Zinc-Base Die Castings	Aluminum	Copper	Brass	Bonderite Cleaning	Remarks
Still and Soak Tanks	Soda ash	X	X	X	—	—	—	—	X	—
	Trisodium phosphate	X	X	X	—	—	—	—	—	—
	Tetrasodium pyrophosphate	X	X	X	X	X	—	—	—	—
	Metasilicate	X	X	X	—	X	—	—	—	—
	Light-duty alkali	X	X	X	—	See Note 2		X	X	—
	Sesquisilicate	X	X	X	—	—	X	X	X	—
	Medium-duty alkali	X	X	—	—	—	X	X	—	—
	Medium-duty (nonetching) alkali	X	X	X	X	X	X	X	—	See Note 3
	Orthosilicate	X	X	X	—	—	—	—	—	—
	Rosin metal cleaner	X	X	X	—	—	—	—	—	—
	Heavy-duty alkali	X	X	X	—	—	—	—	—	—
	Solubilized solvent (used with kerosene)	—	X	X	X	X	—	—	—	Can be used as a dip. Rinse with clear water.
	Solubilized solvent, protective type (used without kerosene)	—	X	X	—	—	—	—	—	Can be used as a dip. Rinse with clear water.
Electrolytic Cleaners	Trisodium phosphate	X	X	X	X	—	—	—	—	—
	Tetrasodium pyrophosphate	X	X	X	—	—	—	—	—	—
	Light-duty alkali	X	X	X	—	—	—	—	—	—
	Metasilicate	X	X	X	—	—	—	—	—	—
	Medium-duty alkali	X	X	X	X	—	X	X	—	—
	Medium-duty (nonetching) alkali	—	X	X	X	X	X	X	—	See Note 3
	Sesquisilicate	X	X	X	—	—	—	—	—	—
	Orthosilicate	X	X	X	—	—	—	—	—	—

Note 1—Soda ash and trisodium phosphate can be used for light-duty cleaning but the mixed cleaners are faster in action and more efficient.

Note 2—Cleaner and etch for aluminum before anodizing.

Note 3—Normal concentrations of this cleaner will only slightly etch nonferrous metals such as aluminum, zinc and their alloys. Where no etching can be tolerated regardless of concentrations, it shall be permissible to add up to 4% sodium sulfite or other satisfactory inhibitors.

Adapted from data in General Motors Standards

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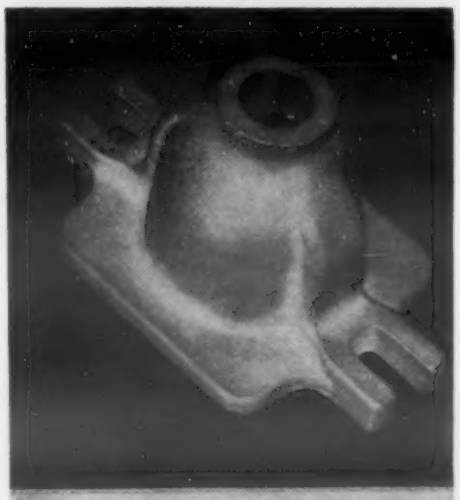
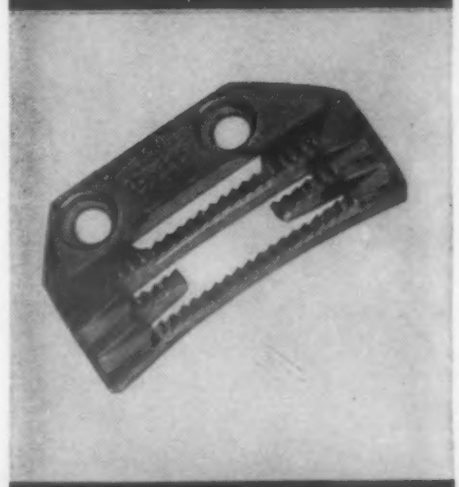


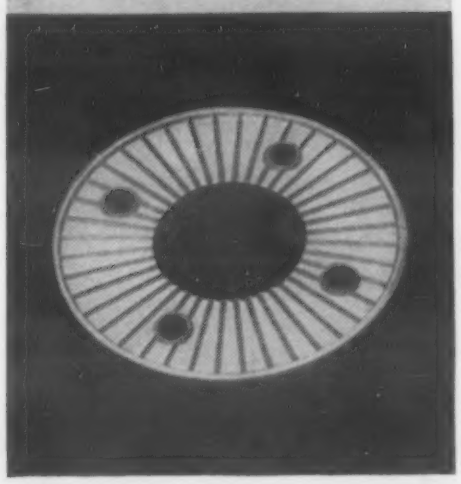
PART: Valve Part
ALLOY: Stainless Steel

This stainless steel valve bonnet for handling liquid food products was investment-cast to produce a smooth as-cast surface. When this part was cast by conventional methods, the cost of polishing made the total cost of the part higher than that of an electro-polished precision casting.



PART: Feed Dog
ALLOY: HAYNES STELLITE No. 6

Here is another typical HAYNES precision-casting job—a feed dog, now produced economically in large quantities. Since this dog operates at high speeds, it was made of HAYNES STELLITE alloy to withstand severe wear and abrasion. Because the part is of intricate shape, the former cost of producing it by machining made the part uneconomical.



PART: Lifter Plate
ALLOY: HAYNES STELLITE No. 3

This part—used in the production of tin cans—is precision-cast of HAYNES STELLITE alloy No. 3 to resist the severe abrasion encountered in high-speed operation. Because the alloy is extremely hard, even at red heat, it is not easily machined, but it can be cast into this intricate shape by investment casting.

The development of the HAYNES precision investment-casting process has opened the way to greater freedom of design of metal parts that must resist heat, abrasion, and corrosion. This new process makes it possible for you to choose an alloy that will give you the best possible service . . . in the shape that will best meet your design requirements. You needn't be concerned about the difficulty of machining, grinding, or forging the alloys that offer the combination of properties you need. HAYNES STELLITE, HASTELLOY, and MULTIMET alloys, as well as various stainless steels are easily cast into intricate shapes by the HAYNES precision-casting process.

Precision investment casting does not compete with low-cost, mass-production methods of manufacture—such as forging, stamping, die casting, or screw machine operations. But precision-cast parts are economical if the shape cannot be produced readily in the required alloy by conventional methods.

Our engineers will be glad to discuss with you the ways in which precision-cast parts may be used in your designs. Just call or write the nearest district office. If you would like more complete information on the subject, ask for a copy of the booklet "HAYNES Precision Castings."

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MATERIALS & METHODS

DIGEST

A selective condensation of articles—presenting new developments and ideas in materials and their processing—from foreign journals and domestic publications of specialized circulation.

Edited by H. R. CLAUSER

The Use of Ceramics for High Temperature Applications

The development of ram-jets, pulse-jets, turbo-jets and rockets has been retarded largely because of the lack of materials that have the required properties at temperatures above 1800 F. And since the requirements for increased performance cannot be met with the present high temperature alloys, much attention is being directed toward the development of ceramics. Investigations are proceeding along three different lines. These are: (1) solid ceramic bodies, (2) ceramic coatings on metals, and (3) ceramic-metal compounds or mixtures. At least three papers describing one or more of these three types have recently appeared.

A paper by A. R. Bobrowsky, presented at the annual meeting of the *American Society of Mechanical Engineers* discussed ceramics and "cermals" with respect to their applicability for turbine use. A number of ceramics and cermals demonstrated their excellent tensile properties at elevated temperatures, and both operated as blades in gas turbines at temperatures above those in service use with alloy blades, although speeds were lower. However, the lives of these materials are still short, primarily because of mechanical design problems. Additional research is required on such factors as elevated temperature fatigue properties.

The use of ceramic coatings for metals to protect them against oxidation at high operating temperatures is being investigated at the *National Bureau of Standards* and is described in a report by D. G. Moore, L. H. Bolz and W. N. Harrison. Ceramic coatings were developed to protect molybdenum, for this metal is of particular interest because of its availability as well as high melting point (4750 F). The results of various tests indicated that the oxidation of molybdenum was greatly retarded by the best of the ceramic coatings tried. No decrease in thickness was found after 70 hr. in an air atmosphere at 1650 F.

An immediate application of these coatings is the protection of molybdenum Pitot tubes which are built into the nozzle end of ram-jet engines for pilotless aircraft. These tubes, which are subjected to a gas temperature of about 3000 F, are expendable and need not last over 5 min.

A short paper by G. A. Bole in the *Engineering Experiment Station News*, Ohio State University, gives a concise description of the properties and methods of producing ceramic-metal compounds. The combination of these two dissimilar materials results in a product that has properties quite different from each alone. They are much less brittle than ceramics, but distinctly less malleable than the metal constituent. They are quite resistant to oxidation at high temperatures. The outstanding property is that they have a strength at high temperatures greater than the constituent metals.

Machining Work-Hardening Steels

Although considerable information has been published on the work-hardening which may occur during the machining of certain stainless and alloy steels, little of it has dealt with pieces that have been accidentally work-hardened during one of the machining stages. W. M. Halliday in *Metallurgia* (English), Sept. 1948, discusses this problem, with particular reference to the machining of austenitic components on screw automatics where this trouble continually arises and where it may lead to other tooling and setting difficulties.

The causes of work-hardening are: dull tools, intermittent or interrupted feed, rubbing of tools, excessive generation of heat, spindle float and slide wear (which cause rubbing rather than cutting), insecurely held tools or work-pieces, and minor machine defects which stop the machine or retard its speed. Much can be done to prevent work-hardening by careful checking of tools, machine settings, equipment and coolants. Extra care should be taken to ensure that all tools are correctly sharpened, honed and lapped to the keenest possible cutting edge.

If the part has already been work-hardened, the most satisfactory corrective measure is annealing. This is often impracticable because of possible warping or dimensional change of the partially finished pieces. Otherwise, if dimensional considerations permit, the most obvious solution is to remove the hardened layer by grinding. Removal of as little as 0.010 in. is sufficient.

A number of seemingly difficult machining problems arising from work-hardening can be overcome by making simple alterations to the normal tool. This is especially true in automatic lathe work. Much can be done to avoid hardening on automatics by designing the slide and turret operating cams to give five feeds, equal to about half those normally used for free-cutting mild steel. It is sometimes possible to remove the hardened layers by feeding the tool into the work from a point behind the hardened face.

Even greater care is needed with twist drills than with lathe tools if work-hardening is to be avoided. Standard drills can often be greatly improved for austenitic steels by modifying the cutting edge clearances, polishing the flutes, and using ample supplies of coolant.

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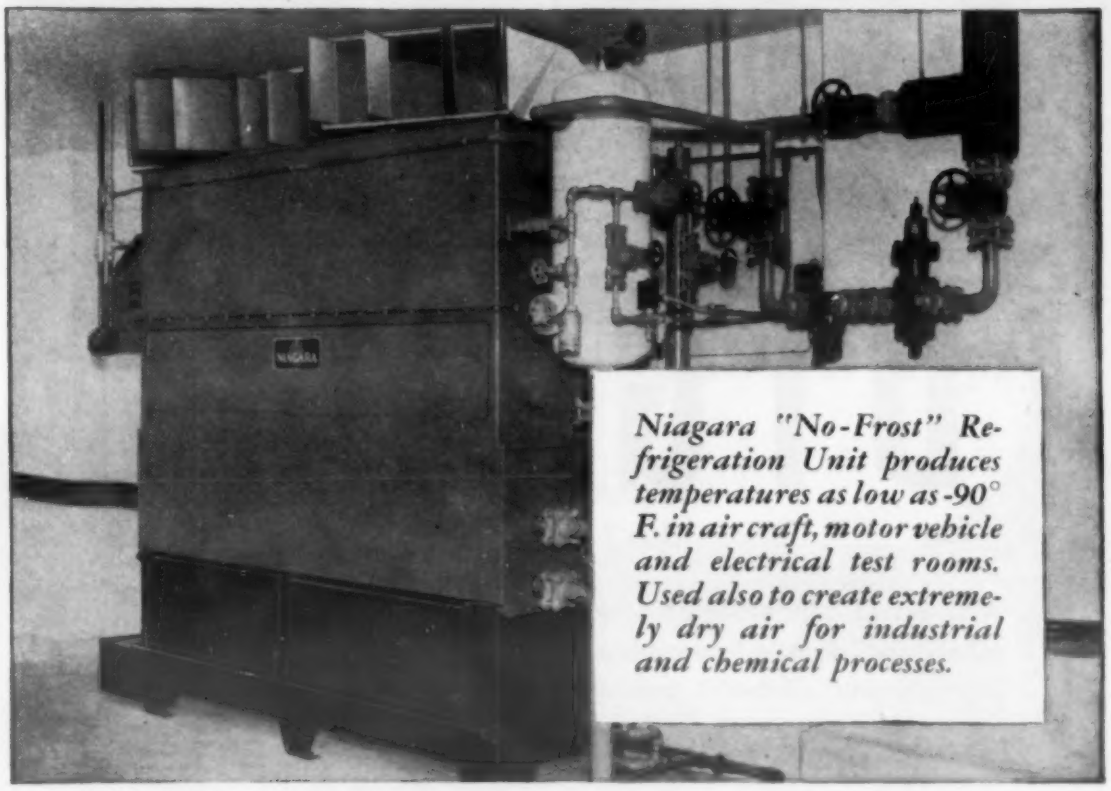

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Reducing Nitriding Time Without Effecting Fatigue Properties

P. H. Frith, in the Aug. 1948 issue of the *Journal of the Iron & Steel Institute* (British), concludes that the nitriding time of nitrided crankshafts can be drastically shortened with no decrease in their fatigue properties. The original aim of his work was to obtain information on the effect of torsional stresses superimposed on a bending stress, and on the effect of nitriding on the stress concentration caused by an oil hole, since no data were available on these subjects despite the fact that nitrided crankshafts have been used for some time.

A widely used British nitriding steel with about 0.2 carbon, 3 chromium and 0.5% molybdenum was nitrided for 10, 22 and 72 hr. at 905 F. Hollow specimens with an oil hole and solid specimens were tested under reversed bending, reversed torsion and various combinations of reversed bending and torsion. The solid specimens failed in fatigue near the junction of the nitrided case and core, but fatigue failure of the hollow specimens started at the surface of the nitrided case.

It would appear that by nitriding crankshafts and airplane propeller shafts for 10 hr. instead of 72 hr., the fatigue limit of the solid components with no stress concentration would be reduced only about 0.7%, while the fatigue limit of the oil-hole sections would be slightly increased. Therefore, from the point of view of fatigue, the 10-hr. treatment would be more suitable than the 72-hr. treatment. The depth of the nitrided case after the 10-hr. treatment was 0.004 in., which should be quite adequate to resist wear. Also, the maximum case hardness was obtained with this treatment.

It seems highly probable that the introduction of the shorter nitriding treatment would make it possible to replace the grinding operation after nitriding by a honing or lapping operation. This change would eliminate the possibility of grinding cracks and would, therefore, simplify the manufacturing process.

A German Survey of Bearing Metals

An excellent survey of the complex field of bearing materials is given by R. Weber in the Aug. 1948 issue of *Zeitschrift für Metallkunde* (German). Service experience and properties are included in this paper in addition to German specifications and 70 references (mainly German).

The choice of a bearing material is of necessity a compromise, since no one ma-

DIGEST

terial is best in all respects. The bearing materials may be divided into "soft" and "hard" alloys. The main members of the former are the lead- and tin-base alloys, with lead-bronze composite bearings for more rigid requirements. In some cases, good results have been obtained with soft aluminum or composite zinc bearings. The combination of a steel backing and a zinc bearing surface appears promising. Iron bearings are not suitable substitutes for white metals, but porous sintered bearings can be substituted for the corresponding cast alloys when the operating speeds are low. Soft bearing alloys cannot be used in applications involving high shock and severe service requirements.

The hard bearing materials include, in addition to tin bronze, primarily special brasses, also lead bronzes and in certain cases complex aluminum bronzes. The tin bronzes can usually be replaced by other copper-base alloys, particularly lead bronze. Hard aluminum alloys have likewise proved satisfactory in place of bronzes, while zinc bearings may be substituted for red brass. Zinc alloys have frictional properties similar to the copper alloys, but their use is limited by abrasion and high service temperatures.

High performance bearings are often made of a triple construction with a supporting shell, an intermediate layer of material with good running properties, and a thin layer with the best frictional properties. Thin bearing layers may be produced by plating, spraying or sintering.

New Standards, Specifications and Patents

Screw Thread Standards Unified

On November 18 representatives of the United States, Canada and England met in Washington to sign an agreement on the unification of the American and British standard systems of screw threads. The difference that cost American industry millions of dollars and many months of time during the recent war was resolved after 30 years of effort among the three nations involved.

The difference between the American thread with an angle of 60 deg. and flat crests and roots, and the British thread, with a 55 degree angle and rounded crests and roots, has been eliminated. The unification agreement provides for a thread with a 60-deg. angle and a rounded root for the screws produced under both the British and American standards. The crest of the thread may be flat or rounded.

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DIGEST

A.S.T.M. Specifications

Solder Metal—Two additional alloys have been added to the group of solder metals, designated 5A and 2A, respectively, with the desired tin at 5 and 2%, respectively, maximum antimony at 0.12, and nominal lead for 5A set at 95%, and for 2A at 98%. With these two new grades there will be 30 grades covered in the specification (B32), with tin-lead, tin-lead-antimony, and silver-lead alloys.

Bearing Alloys—The white metal bearing alloy specification (B23) will incorporate revised chemical compositions for Alloy No. 3. The minimum, desired, and maximum requirements are, respectively, as follows: antimony—7.5, 8.0 and 8.5%; copper—7.5, 8.0 and 8.5%; tin—83.0, 84.0 and 85.0%. Alloy No. 15 is to have the copper requirement of 0.40% min. deleted, and by agreement a narrower range of antimony can be specified.

Aluminum-Base Alloys for Castings—The aluminum-base sand castings specification (B26) revision concerns alloy SC8, which now includes two slightly different commercial alloys. The revision separates the two by establishing alloy SC9 and adjusting the requirements applicable to alloy SC8. The division of alloy SC8 into alloys SC8 and SC9 has also been made in the permanent mold specification (B108); also, a table giving typical yield strengths has been added.

Patents

Valve Steel (No. 2,438,824)—An alloyed steel for valves containing 20 to 22 chromium, 10 to 20 nickel, 2 to 3 tungsten, 0.15 to 0.25 carbon, 0.90 to 1.50 manganese, 0.75 to 1.25 silicon, 0.020 phosphorus max., 0.020% sulfur max., and the remainder iron.

Austenitic Alloy Steel (2,449,023)—A high expansion austenitic steel for use in internal combustion engines containing carbon between 0.35% and usual upper limits of carbon in austenitic steels, 3.5 to 6 manganese, 3 to 7 chromium, 9 to 16 nickel, 0.5 to 12 copper, 0 to 2.0% silicon, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, and the remainder substantially all iron. Steel is normalized at a minimum of 1290 F to obtain optimum physical properties.

● A new process control in the manufacture of a high-temperature alloy for turbine-driven engines was reported by *General Motors Research Laboratories* to the *Optical Society of America*. The control method employs the emission spectrograph,

used also in casting control of other metals. It was developed primarily for analyzing the cobalt-base alloy, commercially known as Vitallium. The method has progressed to the point where analyses can be completed in a matter of minutes during the production process. Samples of the alloy are analyzed from a photographic record of a line spectrum taken from an arc flame burning on an electrode. The Vitallium sample to be analyzed forms one of the electrodes, and carbon is used in the other.

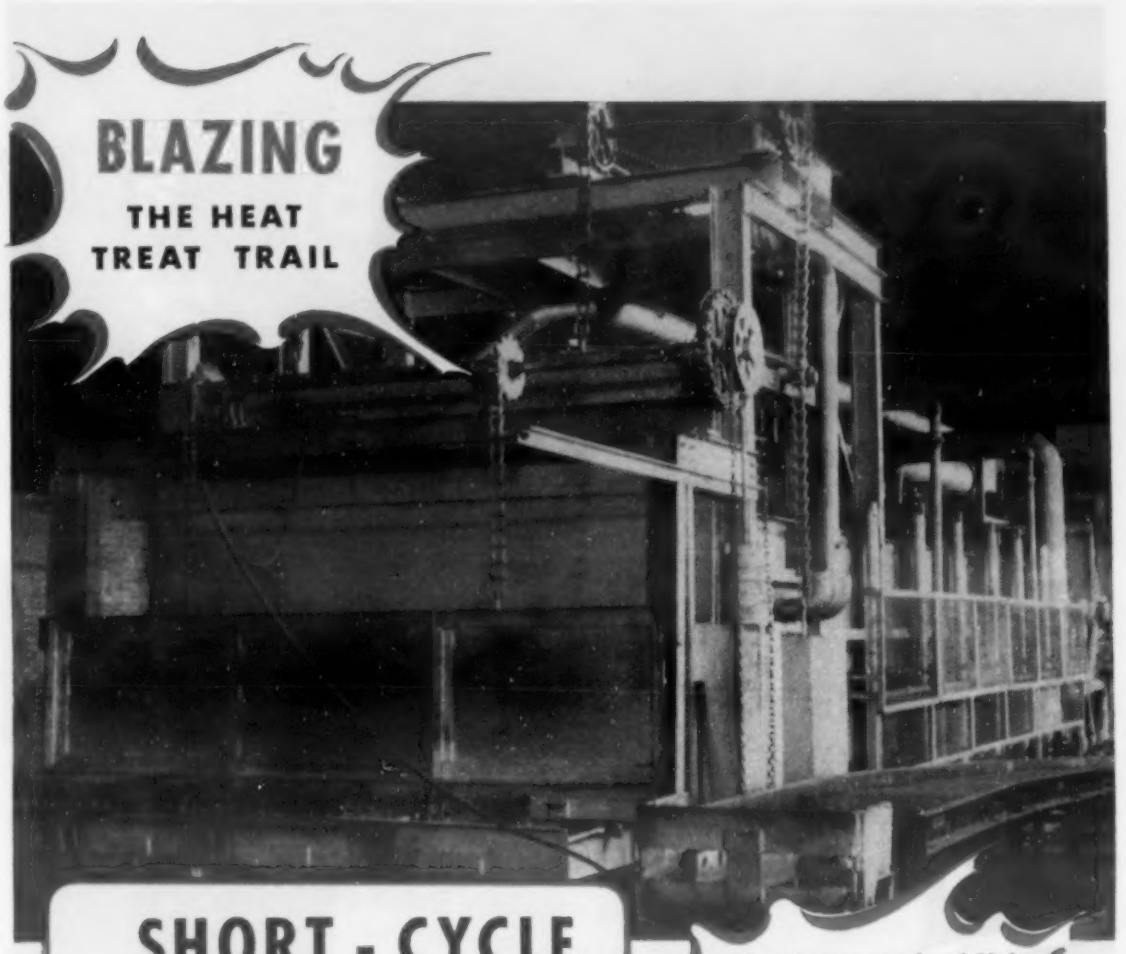
Mechanical Properties of Low Alloy Steels After Isothermal Heat Treatment

The subject of isothermal heat treatment has been repeatedly investigated because of the possibility of minimizing distortion and quenching cracks. A. Pomp and E. Rolf in Vol. 19 (1948) of the *Archiv für das Eisenhüttenwesen* (German) give detailed information on the effect of such treatments on the mechanical properties of two steels corresponding approximately to AISI-SAE 1335 and 6150.

Tensile and impact tests were made on samples isothermally transformed as well as quenched and tempered to various hardnesses. The isothermally transformed samples showed signs of embrittlement after transformation at about 840 F. Otherwise, the conventionally treated specimens had higher impact properties for tensile strengths up to about 188,000 psi. in the manganese steel and 175,000 psi. in the chromium-vanadium steel. At higher tensile strengths, the isothermally transformed specimens were tougher. The isothermally transformed samples also had higher elongation and reduction of area values but lower yield point ratios than the quenched and tempered samples.

The manganese steel was much more susceptible to overheating during austenitizing than the chromium-vanadium steel. Under certain conditions, the overheating reduced the impact of the isothermally transformed samples to less than a third that obtained with lower austenitizing temperatures. When the holding time in the intermediate bath was too short for the steel to transform completely, the hardness was higher and the impact lower than for fully transformed samples.

The elongation, reduction of area and yield point all reached their maximum values for any specific transformation temperature when the steel was fully transformed. Prolonged holding (ten times that needed for transformation) had no noticeable influence on either tensile or im-



Another example of Holcroft "trail blazing"—the first radiant tube continuous furnace for short-cycle malleable annealing, installed more than 10 years ago and still producing economically.

SHORT-CYCLE MALLEABLE ANNEALING FURNACE

DEVELOPED BY Holcroft IN 1936

Short-cycle malleable annealing is a fast, economical process which offers the following advantages to large-volume manufacture:

- The process requires as little as *14 hours*, as compared to *several days* for other methods. This means reduced inventories and faster shipments.
- It produces *clean, scale-free work* which can go directly to shop or assembly without further processing.
- It permits the use of *light-walled containers* — reduces dead weight by as much as 400%, and cuts fuel bills correspondingly.
- It enables large and small castings to be handled simultaneously.
- Compared to other methods, it gives several times the production per unit of floor area.

Although continuous furnaces are most frequently used, this process is also successfully applied to batch-type furnaces. As with all Holcroft furnaces, each installation is *designed individually* for the specific application, thus meeting every requirement of production and quality with maximum over-all economy.

In ordering production heat treat furnaces for ANY need, it will pay you to take advantage of Holcroft engineering leadership. And remember—Holcroft offers you *complete metallurgical and engineering service, from* individual furnace design through the trial run in your plant.

SINCE 1916 Holcroft AND COMPANY

BUILT BY HOLCROFT & COMPANY DETROIT-MICH

PRODUCTION HEAT TREAT FURNACES FOR EVERY PURPOSE

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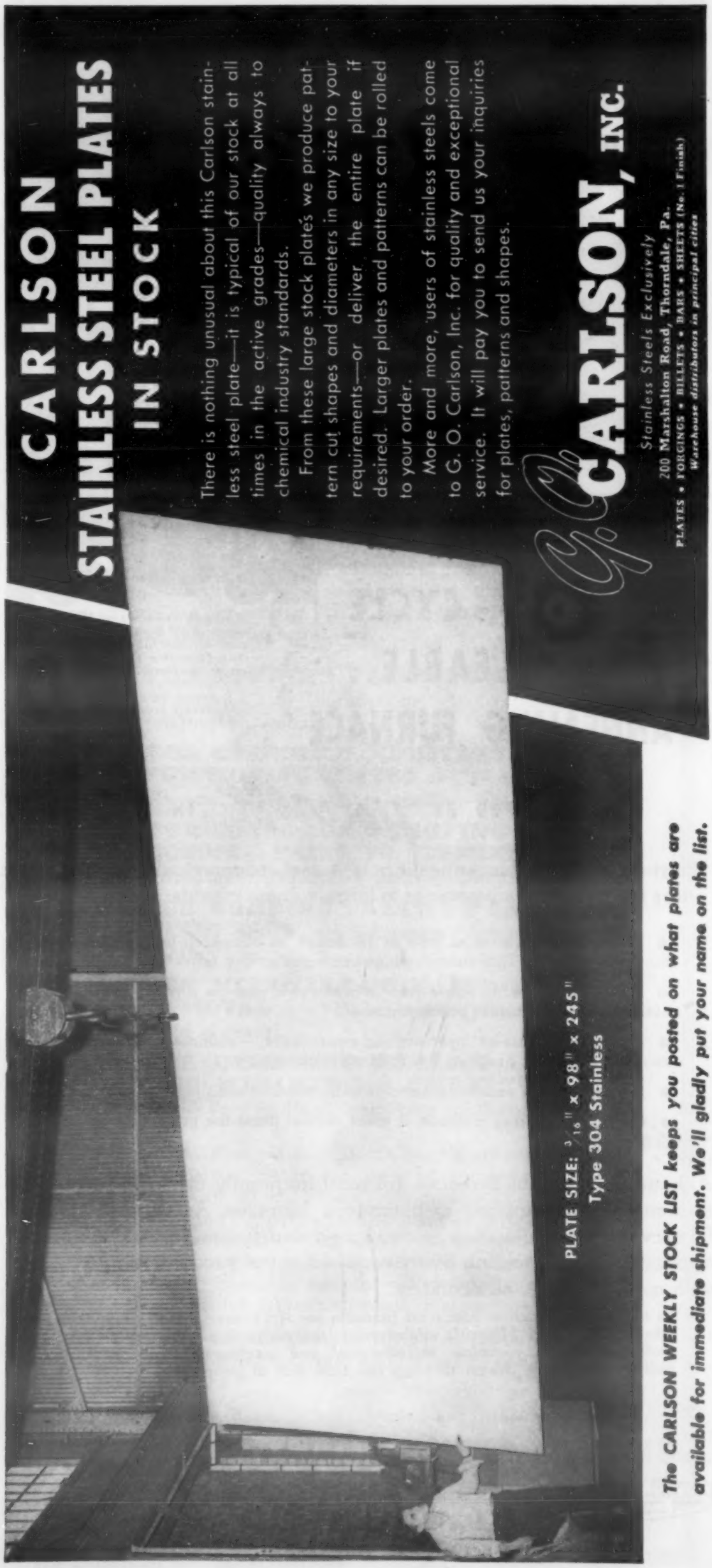
CHICAGO 3
C. H. MARTIN, A. A. ENGELHARDT
1017 PEOPLES GAS BLDG.

CANADA
WALKER METAL PRODUCTS, LTD
WALKERVILLE, ONTARIO

HOUSTON 1
R. E. McARDLE
5724 NAVIGATION BLVD.


CARLSON
STAINLESS STEEL PLATES
IN STOCK
There is nothing unusual about this Carlson stainless steel plate—it is typical of our stock at all times in the active grades—quality always to chemical industry standards.
From these large stock plates we produce pattern cut shapes and diameters in any size to your requirements—or deliver the entire plate if desired. Larger plates and patterns can be rolled to your order.
More and more, users of stainless steels come to G. O. Carlson, Inc. for quality and exceptional service. It will pay you to send us your inquiries for plates, patterns and shapes.
G. O. CARLSON, INC.
Stainless Steels Exclusively
200 Marshalton Road, Thorndale, Pa.
PLATES • FORGINGS • BILLETS • BARS • SHEETS (No. 1 Finish)
Warehouse distributors in principal cities
PLATE SIZE: 3/16" x 98" x 245"
Type 304 Stainless
The CARLSON WEEKLY STOCK LIST keeps you posted on what plates are available for immediate shipment. We'll gladly put your name on the list.

DIGEST

pact properties. Hardenability was determined under conditions of isothermal transformation since it is a factor here as well as in conventional quenching. The maximum size that could be isothermally transformed to tensile strengths over 178,000 psi. was about ½ in. for both steels.

An Improved Basic Bessemer Steel

Despite certain advantages of machinability and weldability, Bessemer steel has the disadvantage of greater susceptibility to work-hardening and strain-age embrittlement than is found in open hearth steel. H. A. Dickie, in the *Journal of the Iron & Steel Institute* (British), Aug. 1948, describes the development of an improved basic Bessemer steel that has proved satisfactory for various uses to which the ordinary Bessemer steel could not be applied.

Preliminary tests established that the differences between open hearth and Bessemer steel disappear when the phosphorus and nitrogen contents of the latter are reduced to values similar to those of open hearth steel. The existing plant facilities were adapted to give a Bessemer steel with these low phosphorus and nitrogen contents, as well as a lower sulfur content.

The new steel can be made rimming, controlled rimming or killed. The last mentioned is restricted in economic application by the lower yield and by the deterioration of surface and weldability. In practice, the lower 60% of the ingots made by the modified process is used for the new quality of steel. The top portion goes to improve the general quality of normal Bessemer supply. A high level of consistency in physical and chemical properties is a feature of this steel.

This improved type of Bessemer steel shows distinctly less work hardening and aging than ordinary Bessemer steel, but it is not fully the equivalent of the softest quality open hearth steel, except perhaps in a selected proportion of the output. This is not without its benefits; for example, the machinability is not sufficiently affected to cause trouble in high-speed threading operations.

Chemically, the new steel is superior to open hearth and ordinary Bessemer steels, because of the purer base reinforced by low nitrogen, phosphorus and sulfur contents. The corrosion resistance and weldability are therefore improved. It also results in better surface finish and in increased resistance to penetration of scale. The steel is very soft magnetically, again being better than open hearth or ordinary Bessemer mild steel. When properly heat treated, it can be applied effectively to uses requiring high permeability and low hysteresis loss.

DIGEST

Creep Strength of Magnesium Alloys

Many of the proposed applications for magnesium alloys involve service at elevated temperatures, and in such service creep strength becomes an important factor. H. Vosskühler in *Zeitschrift für Metallkunde* (German), July 1948, presents data at temperatures up to 570 F for eight cast and eight wrought alloys (some in more than one condition).

At higher temperatures, cast alloys had higher creep strengths than wrought alloys of the same composition; at lower temperatures, the wrought alloys were superior. Also, a coarse grain gave higher values at higher temperatures than a fine grain size, but the picture was reversed at lower temperatures. No significant difference could be determined between the creep strength of a sand cast alloy and that of the same alloy cast in permanent molds. Neither did the common homogenization and heat treatments produce any appreciable change in the creep strength. At temperatures up to 210 F, the creep strength increased with the aluminum content. At higher temperatures, the lower aluminum cast alloys had higher creep strengths, while there was no relationship between the aluminum content of the wrought alloys and their creep strength at these temperatures.

A comparison of the creep values with the results of tensile tests showed that the creep strength of magnesium alloys must be considered even for room temperature service. It is believed necessary to differentiate between the creep strength corresponding to a certain creep rate and that corresponding to a certain permanent elongation. It is probably possible to determine from the first type of creep strength the load that will cause failure. The significance of the second type of creep strength depends on the type of part in question, its desired life and the permissible deformation in service.

● Results of research on sigma phase, a brittle compound formed by certain alloying atoms in steel when subjected to high temperatures, were recently disclosed in a paper by O. Zmeskal, P. K. Koh and J. J. Gilman of the *Illinois Institute of Technology*. The rate and amount of sigma phase formed was found to be influenced markedly by the amount of cold working previously received by the alloys. The more cold working, the more rapid and greater is the formation of sigma phase. These findings are expected to find application especially in the construction of jet engines.

ACE

John R. MacKay tells:

HOW TO RECOGNIZE A JOB FOR HARD RUBBER

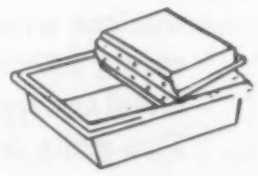
How can a man think straight about materials when so many new ones are always popping up. Now take hard rubber, for instance.

It's been all around us for nearly a century. Let's clamp down on our hard rubber pipe bits, ease ourselves down on our rubber casters, and take a good look. From an impartial viewpoint. (*We* can, because Ace molds *both* hard rubber and other important plastics).

First, we see dozens of grades of hard rubber, and they're all different. Generally speaking, they're black beauties, easily polished, with a real nice feel. *Good* for handles, grips, pipe bits, knobs, combs, etc.

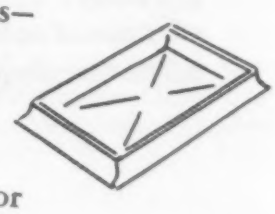
We see it's tough, stable stuff that's well nigh impervious to water and 'most all known chemicals. (Except mineral oils and organic solvents— but Ace *synthetics* take care of them.) Its resistance to water is topped only by Ace polyethylene.

Tensile strength of hard rubber is up with the best plastics—up to 9,700 psi. Coefficient of expansion is very low—good for refrigerator parts. For the hot spots, we can give you compounds that won't distort up to 250° F., but don't count on more than 150° from any general purpose mix.



You probably know all about the top-notch electrical properties of hard rubber. But did you know its wear resistance is so good it's often used in bearings? So tough it's used in bowling balls.

Add it all up—Ace hard rubber is good for a lot of things—water meter parts, magneto parts, foot tubs, vinegar dumpers, fountain pen parts, sparges (if you know what *they* are) and chemical piping. It's probably natural for a lot of things you make, too.



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ACE

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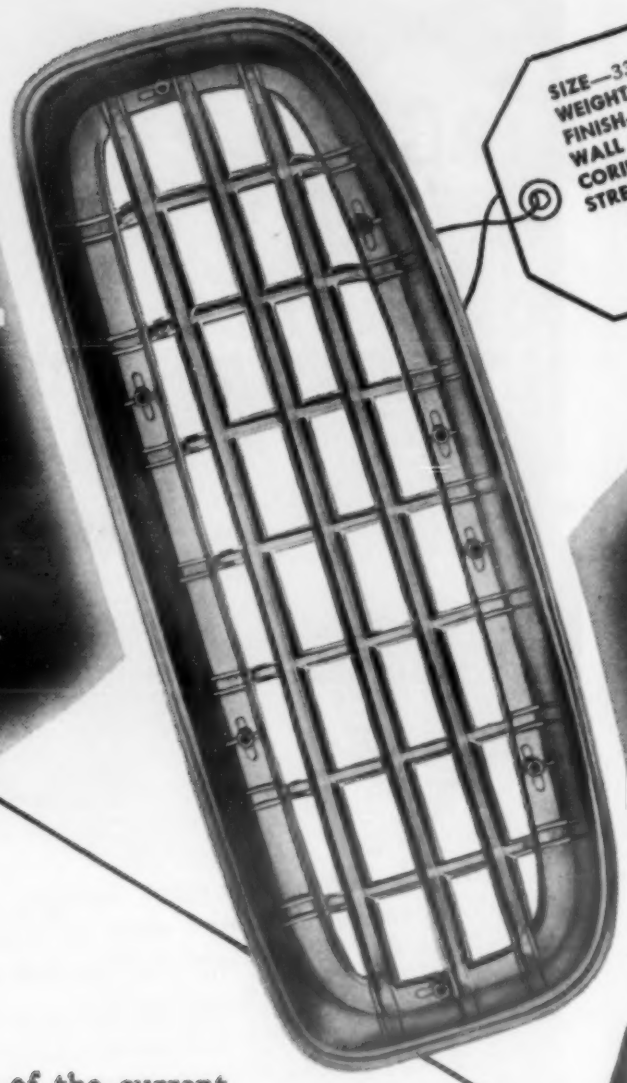
AMERICAN HARD RUBBER COMPANY

11 MERCER STREET • NEW YORK 13, N. Y.

massive appearance- through *clever coring*


SIZE—33½" x 13½"
WEIGHT—12¾ lb.
FINISH—Chromium plated
WALL THICKNESS OF THE RIBS—.070"
CORING—All grille openings cored
STRENGTH OF THE ALLOY—
Over 40,000 lbs. / sq. in. tensile
Over 40 ft. lbs. impact—¼" bar
(Strength values determined on test bars)

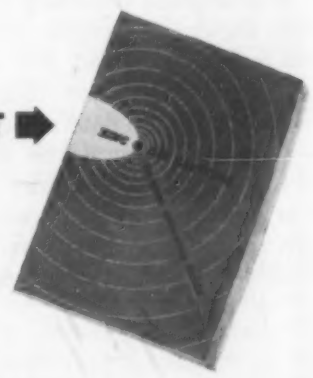
another successful product designed for ZINC DIE CASTING

The radiator grilles of many of the current cars are built-up assemblies of die cast parts, but this particular design—for the 1949 Nash Airflyte— is a one-piece zinc die casting. Not only does a die casting meet the physical and mechanical requirements of this design (see tag on casting), but it consumes a minimum amount of metal.

The grille casting is shown from the rear to reveal the clever coring of the horizontal and vertical ribs. The ribs thus appear to be solid sections when viewed from the front, but the coring effects a considerable saving in both metal and weight—with no sacrifice of strength! This grille is tailored to fit the car instead of vice-versa and its inherent dimensional accuracy greatly reduces assembly problems. Note, also, the cast assembly bosses.

This is just one of many successful applications for zinc die castings in the automotive industry. Typical applications in other fields of manufacture will be covered in future advertisements in these pages.

SEND FOR THIS BOOKLET ➡

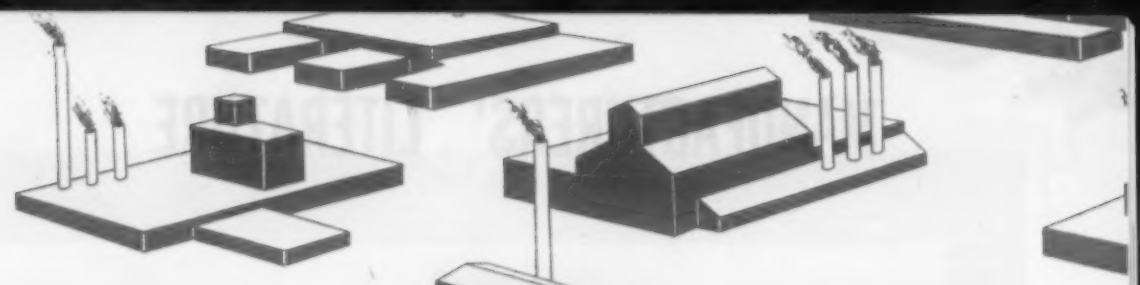


A new booklet—just off the press—has 64 pages of photographs depicting zinc die castings in the assembly of a wide variety of products in many fields. Send for your copy today!

ZINC
FOR DIE CASTING ALLOYS

THE NEW JERSEY ZINC COMPANY, 160 Front St., New York 7, N. Y.

The Research was done, the Alloys were developed, and most Die Castings are based on
HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC



MANUFACTURERS' LITERATURE

Materials

IRON AND STEEL

Cold-Finished Steel

Complete data on cold-finished Jalcase steel, a free-machining open hearth steel used in the production of machined parts where high mechanical properties and good response to heat treatment are required, are presented by the Jones & Laughlin Steel Corp. in a 12-page, illustrated bulletin. Typical applications are also included. (1)

Stainless Steel

The chemical composition, mechanical properties, physical properties, and heat and corrosion resisting properties of Miscrome 1, a hardenable stainless steel that can be hardened by heating to 1775 to 1850 F, held sufficiently long to ensure uniformity of heat, and cooled in air or oil, are tabulated in this 2-page bulletin, issued by the Alloy Casting Div. of the Michigan Steel Casting Co. (2)

Cold Finished Steel Bars

Among the cold finished steel bars covered in this 8-page, illustrated bulletin are low and high carbon shafting quality, screw steels, and carburizing steels, available in the form of rounds, squares, hexagons, flats and angles from Joseph T. Ryerson & Son, Inc. (3)

NONFERROUS METALS

Brass Sheet, Strip, Rod, Bar, Etc.

The chemical composition, physical and mechanical properties, specifications and typical applications of a large number of standard copper-base alloys in the form of sheet, strip, rod, bar, wire and special shapes furnished in various degrees of softness or hardness, depending on requirements, are all included in this 8-page, illustrated bulletin, offered by the Bristol Brass Corp. (4)

Powder Metallurgy

The fabrication of products and parts from MRCO copper, iron and lead powders is interestingly presented in sections on how the things are made from metal powders, what can be made from metal powders, and the advantages and limitations of powder methods of manufacture. This 16-page, illustrated bulletin is offered by the Metals Refining Co., Div. of the Glidden Co. (5)

PARTS AND FORMS

Metal Conveying Belts

Bulletin No. 546, four pages, describes and illustrates Metalwove continuous conveying belts, made of any ductile metal in various types of weaves to resist heat, acid and corrosion. Audubon Wire Cloth Corp. (6)

Flexible Metal Coolant Hose

A complete line of Stay-Put flexible metal coolant hose, designed especially for conducting coolants on machine tools, is described and illustrated in a 4-page bulletin, No. CH-48, offered by the Wheelock Manufacturing Div. of the Chicago Metal Hose Corp. (7)

High Alloy Castings

The facilities of the Electro-Alloys Div. of the American Brake Shoe Co. for producing Thermalloy and Chemalloy—high alloy castings that are heat, corrosion and abrasion resistant—are profusely illustrated and described in this attractive, 58-page catalog, No. T-155. Recommended applications of these castings in a variety of industries are included. (8)

Stainless Steel Tubing

Detailed specifications and typical applications of both Globe seamless stainless steel tubing and Gloweld electric welded stainless steel tubing are featured in this 4-page, illustrated bulletin, No. 115 A, released by the Globe Steel Tubes Co. (9)

Self-Lubricating Bushings

Complete data covering self-lubricating bushings made from various grades of Graphalloy, a unique and useful anti-friction material consisting of graphite or carbon-graphite in solid molded form, the pores of which are impregnated with molten metal, are presented in an 8-page, illustrated bulletin offered by the Graphite Metallizing Corp. (10)

Screw Thread Inserts

Design, specifications and installation data on Heli-Coil screw thread inserts for cap screw, stud, pipe thread and spark plug assemblies in iron, steel and light metal castings, forgings and machined parts, as well as in plastic materials and wood, are included in this 12-page, illustrated bulletin, No. 248, released by the Heli-Coil Corp. (11)

Flat Die Forgings

Both maximum and minimum sizes of flat die forgings, such as rings, sleeves, spindles, gear blanks, shafts, bars, etc., are diagrammed in this 4-page bulletin released by the Kropp Forge Co. (12)

Iron Castings

Complete data on Meehanite castings, noted for their ease in cutting and the smooth, even, highly polished finish which can be applied to them, as well as detailed instructions on how to machine these castings, are contained in this 20-page, illustrated bulletin, No. 29, offered by the Meehanite Metal Corp. (13)

Drop Forgings

Specifications and prices of a complete line of standard drop forged hardware items and special contract forgings are included in this 20-page, illustrated booklet, issued by Merrill Brothers. (14)

Industrial Wire Cloth

A broad, diversified line of metallic wire cloth, screen and woven wire products produced in any commercial size, in all weaves and from all malleable metals, is discussed in this 4-page, illustrated bulletin, offered by the Newark Wire Cloth Co. (15)

Zinc Alloy Die Castings

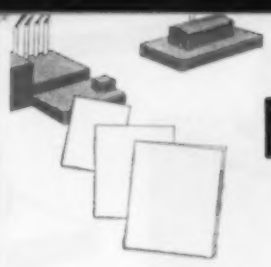
The more salient features of Zamak-3 and Zamak-5 zinc alloy die castings, their method of production, and typical applications are all reviewed in this 28-page, illustrated booklet, available from the New Jersey Zinc Co. (16)

Small Precision Castings

The many advantages provided when using small precision castings in most any castable metal, produced by the Precise Castings Corp., Div. of the Cooper Alloy Foundry Co., are listed in this 8-page, pocket-size, illustrated booklet. (17)

Stainless Steel Tubing

The facilities of the Trent Tube Co. for producing Trentweld stainless steel, Monel and Inconel tubing in sizes from ⅛ to 22 in. in dia. in long lengths or up to 30 in. in dia. in shorter lengths are illustrated and described in this 16-page bulletin. Numerous tables and specifications are included. (18)



MANUFACTURERS' LITERATURE

Precision Investment Castings

The physical and chemical properties, solubility, typical applications, and casting method of Tantung castings—produced by either the wax or plastic model process of precision investment casting—are all included in this 12-page, illustrated bulletin, No. V-R 460, issued by the Vascoloy-Ramet Corp. (19)

PLASTICS

Laminated Plastics

The first issue of an attractive new house organ, published by the Formica Co., contains articles and illustrations on the use of decorative and industrial laminated plastics in a variety of industries. (20)

NONMETALLICS

Glass Products

A complete line of lenses, indicator glasses, direction and safety lights, sight glasses, instrument cases and mechanical parts, and color filters, as well as the facilities of the Kopp Glass, Inc. for producing these products, are described and illustrated in this attractive 24-page catalog. (21)

Glass Fiber Products

This 8-page, illustrated bulletin, No. G48-4, lists detailed descriptions and applications of various Fiberglas products, including insulating Wool Type TW-F, PF (preformed) insulations, superfine insulations, thin porous mats, reinforcements for plastics, etc. Owens-Corning Fiberglas Corp. (22)

Carbon-Graphite

Complete data on Graphitar, a carbon-graphite nonmetallic product that resists chemical attack, has self-lubricating properties and a low coefficient of friction, is as hard as steel and lighter than magnesium, and will not warp, are presented by the United States Graphite Co. in a 40-page, illustrated catalog. (23)

Methods and Equipment

HEAT TREATING

Ovens

Gehnrich & Gehnrich, Inc. has issued a 32-page, illustrated planning guide which shows how to select the right oven for each individual heating, heat treating, drying, baking and curing process. Specifications of seven basic oven and heater types, and typical applications, are included. (24)

Liquid Electrode Furnace

The many advantages of using the Model 601 liquid electrode furnace, or converting an old type electrode furnace to this new principle, are featured in a 4-page, illustrated bulletin offered by the A. F. Holden Co. A wide range of typical applications are included. (25)

Heat Treating Furnaces

The Loftus Engineering Corp., designer and builder of individual furnaces and complete plants for the ferrous and nonferrous industries (from the open hearth through to the finished product), describes and illustrates in this 4-page bulletin a variety of heat treating furnaces engineered, designed and constructed in its plant. (26)

Furnace Atmosphere Control

The Urquhart combustion process for maintaining controlled atmosphere in industrial furnaces, and which can be installed in your present furnace with a minimum of changes, is described in this 4-page, illustrated bulletin, available from the Steel Processing Co. (27)

Oven Furnace

The extreme flexibility of a semi-muffle oven furnace, possessing a wide heating range of from 300 to 2400 F for such operations as annealing, carburizing, hardening, preheating, tempering and general heat treating, is revealed in this 2-page, illustrated bulletin just released by the Sunbeam Stewart Industrial Furnace Div. of the Sunbeam Corp. Specifications are included. (28)

Electric Salt Bath Furnaces

The attainment of complete commercial heat treating for all types of work through the use of electric salt bath furnaces produced by the Upton Electric Furnace Div. is described and illustrated in a series of three 2- and 4-page bulletins inserted in a 4-page folder that lists all the companies already using these furnaces. (29)

WELDING AND JOINING

Gas Shielded Metal Arc Welding Process

Complete data on the new Aircomatic process, which was introduced by the Air Reduction Sales Co., are presented in a 6-page, illustrated reprint entitled "The Development of the Gas Shielded Metal Arc Welding Process." (30)

Blind Rivets

A variety of typical applications using one-man blind rivets, available in self-plugging and pull-through hollow types in steel, Monel and alloys of aluminum, are described and illustrated in this 6-page folder, No. S2-15, issued by the Cherry Rivet Co. (31)

Electric Rivet Heaters

Suggestions on taking care of electric rivet heaters, as well as detailed diagrams showing all the parts of both two-electrode and three-electrode rivet heaters, are featured in this 4-page, illustrated bulletin, released by the Frank C. Cheston Co. (32)

Cutting Shear

Operating instructions, construction and specifications of the Truedge shear that offers numerous advantageous features are included in this 2-page, illustrated bulletin, available from Elge Associates. (33)

Low Temperature Welding Rods

Bulletin No. AM-30, four pages, describes and illustrates a complete line of low temperature EutecTrodes for arc welding and low temperature EutecRods for torch welding, both produced by the Eutectic Welding Alloys Corp. Typical applications for each item listed are also included. (34)

Tungsten Electrodes

The many advantages of using tungsten electrodes containing 99 9/10+% pure tungsten, produced by the Fansteel Metallurgical Corp. for use in helium, argon or atomic hydrogen arc welding, are featured in this 4-page, illustrated bulletin, No. 1.102. Specifications and prices are included. (35)

Fluxes

A list of 22 Nalco fluxes that will meet every type of soldering need of the average solder user is presented in a 4-page booklet, published by the National Lead Co. (36)

Automatic Stud Welding

Typical applications of the Nelson stud welding process, which supplies a dependable, automatically-controlled means of end-welding studs to metal surfaces, thus eliminating drilling, tapping or hand-welding, are featured in this 4-page, illustrated bulletin, issued by the Nelson Stud Welding Corp. (37)

Self-Tapping Screws

Numerous types and sizes of hardened self-tapping screws for every assembly operation of metal and plastics are described and illustrated in this 20-page, pocket-size booklet, published by the Parker-Kalon Corp. Specifications and typical applications are included. (38)

Self-Locking Nut

The Prestole Corp. has issued a 2-page bulletin describing a new self-locking "Snap Nut", which can be pressed into assembly position from work surface without any welding, riveting or clinching. This nut can be used with either a No. 8 or No. 10 sheet metal screw. (39)

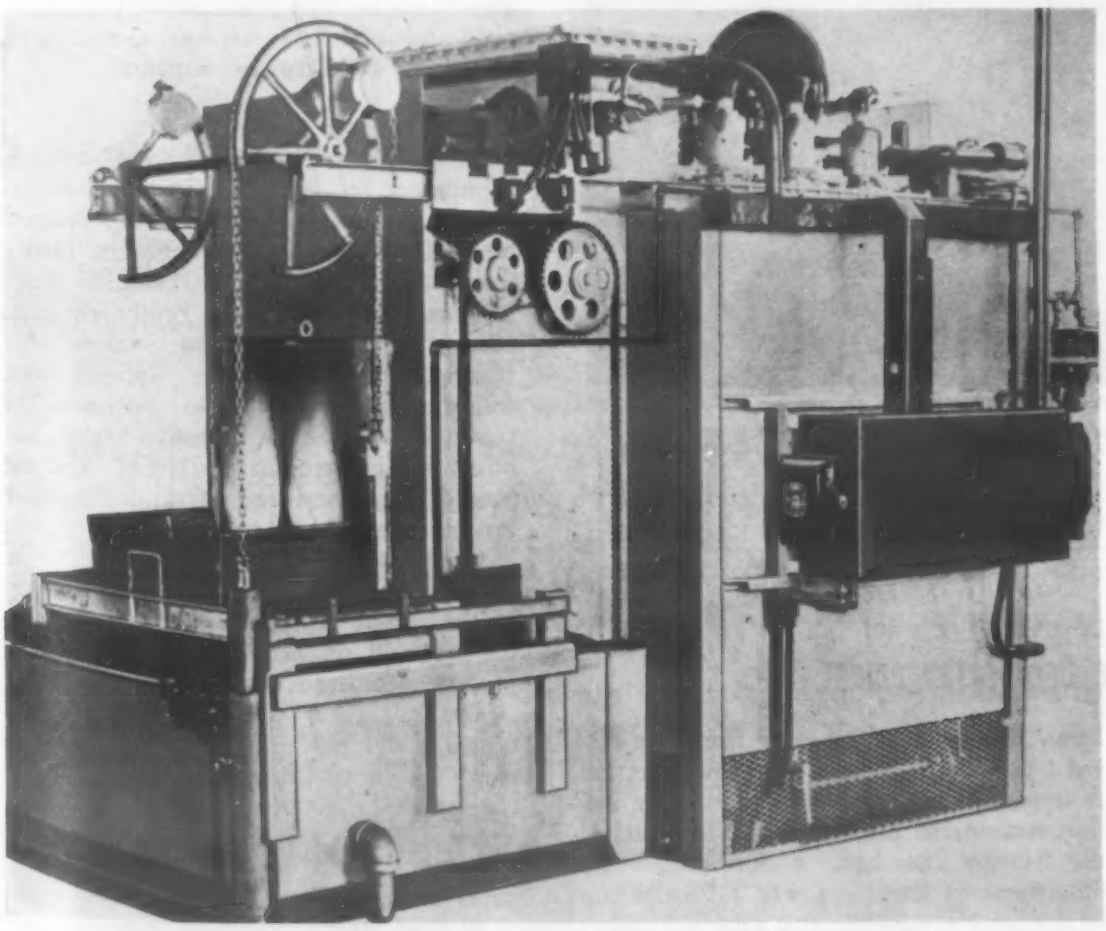
New Materials and Equipment

Batch Type Furnace Gas Cyanides Uniformly

A new batch-type furnace for gas cyaniding has been announced by the *Dow Furnace Co.*, Maccabees Bldg., Detroit 2. With a rated capacity of 600 to 700 lb. per hr., a uniform case depth is said to be produced throughout the furnace load with a variation of ±0.0005 in. on a 0.003-in. case.

Design features of this unit include a screw drive mechanism for loading and unloading the furnace; higher speed of heating by means of 6 U-type radiant tubes surrounded by a "heat capacitor." A gas generator system of catalytic type is incorporated in the radiant tubes to supply a gas neutral to medium high carbon steels.

Additional design features include safety controls, oil circulation and oil cooling equipment, 1½-h.p. drives for inner door and quench tank elevator, circulating fan, and gravity roll tables for stock handling. Floor space is approximately 7 ft., 6 in. wide and 12 ft., 6 in. long, requiring head room of approximately 13 ft., 6 in.



This unit is suitable for gas cyaniding, gas carburizing and clean hardening.

Punched Silicone Rubber Products Have Wide Application

A new line of punched silicone rubber products has been announced by the *Stalwart Rubber Co.*, Bedford, Ohio. They are said to have a wide range of application in many fields of industry, including chemical processing, petroleum, automotive and aeronautical, and in laboratory operations.

Punched products, such as gaskets, washers, seals and packings, can be used in processing systems handling hot or cold fluids or gases and wherever rubber comes into contact with extreme hot or cold conditions. These products also can be used to replace certain metal constructions in which limited thermal stability has been experienced. Standard and unusual flat shapes punched from cured sheets of silicone rubber can be made to exacting specifications, and the location of bolt holes held to practical accuracy.

Silicone rubber distinguishes itself from other rubbers in that it can withstand extreme temperatures ranging from —150 to 500 F. It has all the desirable characteristics of natural rubbers in addition to special properties, and is suitable for dielectric applications. It is resistant to permanent compression, prolonged weathering, lubricating oils, and some chemicals, and has excellent water repellency. It will not become brittle or hard, and will not crack after long exposure to air, ultra-violet rays, or ozone.

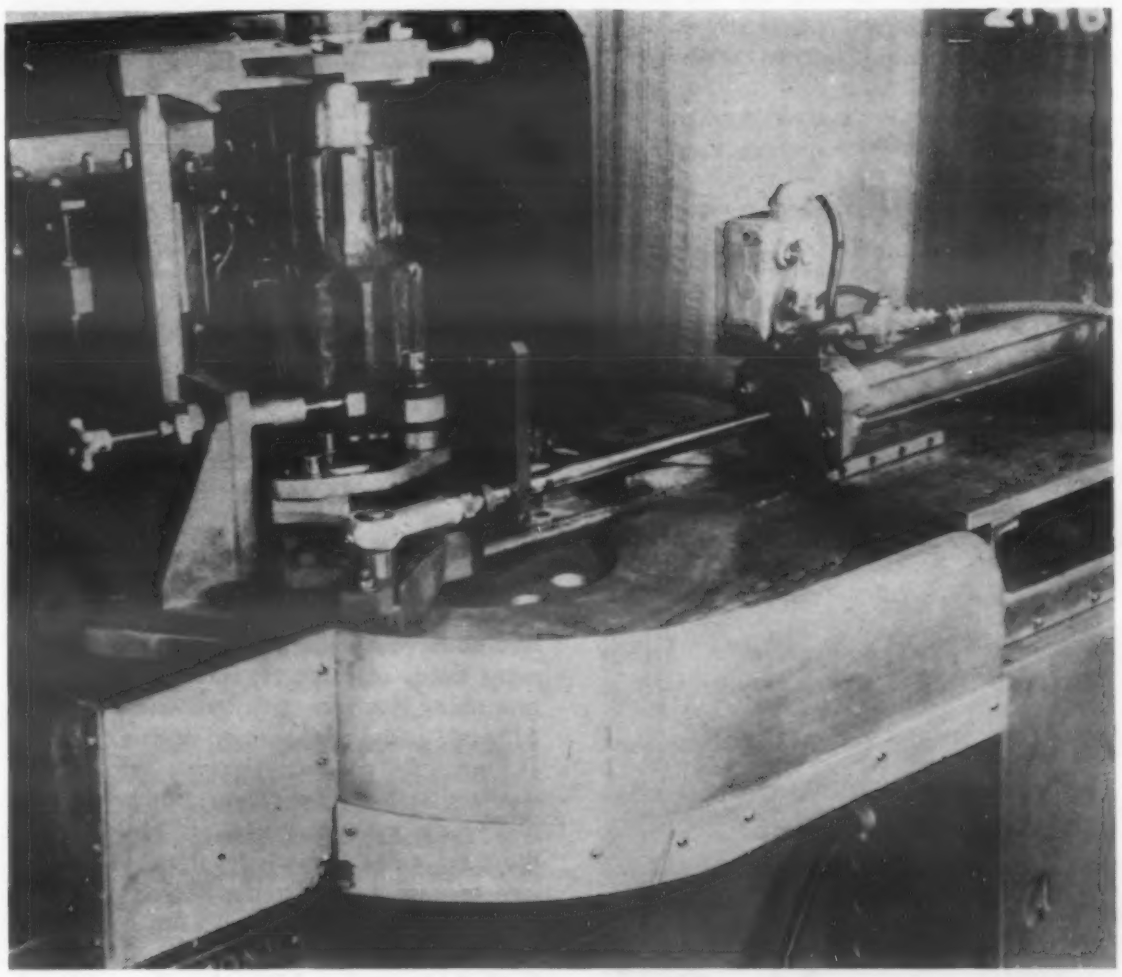
New Materials and Equipment

Automatic Machine Speeds Up Induction Hardening of Gears

An automatic heating, quenching and indexing unit for hardening of gear teeth, one tooth at a time, by induction heating has been developed by the *Induction Heating Corp.*, 181 Wythe Ave., Brooklyn 11, N. Y. Handling operations involve only the insertion and removal of gears.

Gears ranging from 20 in. in dia. with a 12-in. face or larger, depending upon generator capacity, are accommodated by this unit. The savings in power consumption and labor are said to make it particularly adaptable both for high or low production requirements.

Upon pressing the start button after the gear is inserted, each tooth of the gear is automatically indexed, heated and quenched until every tooth has been processed. The machine can be mounted on any conventional sink table. The controls are contained in a cabinet, which is attached to the unit.



A tooth of a pinion gear engaged in the heating coil of the gear hardening machine.

New Furnace Has Unique Door Arrangement

To permit access to the heating chamber with minimum loss of heat, the *Thermo Electric Mfg. Co.*, 493 Locust St., Dubuque, Iowa, has employed a unique door arrangement in their new series of electric furnaces. The door has been divided into an upper and lower section, and both sections are controlled by a single counter-balanced lever. By moving the lever from the forward position to vertical, the lower section is lowered separately while the upper section remains in place over the top half of the heating chamber. A further 60-deg. movement of the lever will raise the top section and expose the full chamber. Both door sections move on parallel levers in a vertical plane with the hot side always away from the operator.

Other features include an all-steel body of welded construction and 6 in. of dual insulation. The elements are embedded in refractory plates which form the sides, top and bottom of the heating chamber.

These furnaces are supplied with either a temperature controlling and indicating instrument or with an electronic controlling pyrometer. The furnaces may be operated continuously up to 1650 F and intermittently to 1900 F. The furnaces are built with a chamber opening of 8½ in. by 7½ in., and in depths of either 13½ in. or 18 in. Operation is on 230 v., 50/60 cycles, single phase.

New Finishes and Coatings

Enamel Resin

A new type of synthetic resin for fast-drying enamels has been developed by the *Coating Resins Dept., American Cyanamid Co.*, 30 Rockefeller Plaza, New York 20. The new resin is a chemical copolymer of styrene and alkyds, and will be marketed under the trade mark of Cycopol.

The resin is said to be especially adapted for use in industrial finishes, and in fast-drying household enamels. Its important characteristics, in addition to its fast drying, are pale color, excellent toughness and adhesion to metal surfaces, a high degree of durability, high gloss, and good color retention.

Enamels made with the resin may be brushed or sprayed and should find extensive use in high grade enamels for household and industrial purposes, as well as for machinery and farm implements.

Bright Chromate Coating

Allied Research Products, Inc., 4004 E. Monument St., Baltimore 5, Md., have announced a new Iridite bright dip designed especially for use in automatic zinc plating installations. This new formulation makes it possible to obtain a bright chromate coating using only three stations after plating. These are: rinse, dip, and rinse, followed by the usual drying methods. The coating brightens zinc, resists stains, and offers good corrosion resistance. The degree of brightness and corrosion resistance can be controlled by the operator.

One of the features of the coating is the use of nitric acid, along with an equal part of the bright dip concentrate, to replenish the working solution and keep the pH at proper operating levels.

The salt spray corrosion resistance obtained under production conditions is normally 24 hr. to 48 hr. for the bright, clear chromate film, increasing upwards to 100 hr. as iridescence is increased.

Latex Compound and Plastisols

A new latex compound especially designed for applications requiring high heat

more **HOME APPLIANCES PER TON—**

more **DURABILITY PER APPLIANCE WITH**

N-A-X HIGH-TENSILE STEEL

N-A-X HIGH-TENSILE saves three ways when used in the manufacture of home appliances.

Because of its inherent high strength and toughness, up to 33% more units per ton can be produced than with ordinary carbon sheet steel.

Because sections can be made lighter without sacrifice of strength or durability, handling weight can be reduced, packaging and shipping costs lowered.

N-A-X HIGH-TENSILE provides a smoother surface texture when drawn, permitting substantial savings on finishing.

Why not investigate the possibilities of N-A-X HIGH-TENSILE for your products?

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
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HIGH-TENSILE STEEL

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IN YOUR AMMONIA?

Purity is paramount in Mathieson Ammonia. Only highly refined hydrogen and nitrogen gases are used in its manufacture. Combined chemically, these gases—wholly dry, and devoid of foreign substances—produce the purest ammonia obtainable.

This purity is protected right up to your furnaces or dissociator. Mathieson carefully inspects every cylinder and valve before filling. After filling, the cylinder is double checked to insure freedom from moisture, non-condensable gases and other impurities. That's why you get dependable, trouble-free service from every cylinder of Mathieson Ammonia. Prompt deliveries in 100- and 150-lb. cylinders from the nearest of 44 warehouses. Free 40-page booklet: "Ammonia in Metal Treating" will be sent at your request. Mathieson Chemical Corporation, 60 East 42nd St., N. Y. 17, N. Y., *formerly The Mathieson Alkali Works (Inc.)*.

Mathieson
AMMONIA

Ammonia, Anhydrous & Aqua...Caustic Soda...Soda Ash Bicarbonate of Soda...Liquid Chlorine...Dry Ice...Chlorine Dioxide...HTH Products...Fused Alkali Products...Sodium Chlorite Products...Carbonic Gas...Sodium Methylate

New Materials and Equipment

resistance, and a new series of plastisols, are now being marketed by *American Anode, Inc.*, 60 Cherry St., Akron, Ohio. A plastisol is a dispersion of resin and other compounding materials in a plasticizer containing no volatile organic liquids as diluent.

The latex compound, known as Anodex HR, has a combination of high heat resistance, good chemical resistance, high elongation, and high tensile strength, according to the company. Articles coated, dipped, sprayed or brushed with it will withstand temperatures as high as 400 F, retain tensile strengths up to 2500 psi., and have elongation up to 1000%. Potential applications include heat resistant coatings for textile and fabrics, insulating tapes and papers, heat and oil resistant gaskets, hose, belting, oil seals, and other mechanical applications.

The new series of plastisols, known as Ameron resin paste, are free from entrapped air. They may be used for coating metal and wire, plating racks, pipe lining, wood, textiles and paper; molding toys, industrial boots, and gaskets; or casting film and sheeting. They will be available in a wide variety of colors and will be formulated to customers' specifications.

Strippable Coating

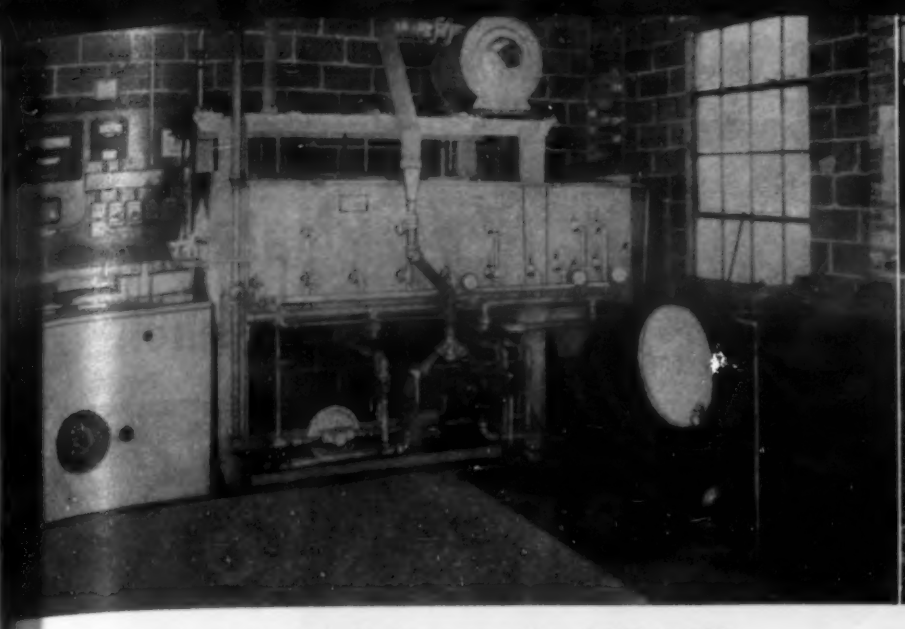
A removable protective coating which protects polished metal stock from die marks, scratches and abrasion during cupping, forming and drawing operations has been introduced by *Minnesota Mining & Manufacturing Co.*, 900 Fauquier Ave., St. Paul 6, Minn. The compound has a synthetic resin base and a solvent vehicle.

The coating can be sprayed, brushed or roll-coated on finished metal surfaces. It can be left in place from the mill to the point of sale, throughout fabrication, and can be hand-peeled off in large sheets or blown off with compressed air.

The coating, available in a variety of colors, is applicable to glass and other nonporous materials as well as metals. It provides a translucent film which is shock absorbent and abrasion resistant, and is said to have excellent resistance to water, gasoline and oil. Coverage is 250 to 300 sq. ft. per gal. for a one mill sprayed coating, which air-dries in approximately 3 min. or can be oven-dried in less than a minute.

Rust Proof Coating

A semi-porcelain rust proof coating which is cured at 350 F and withstands 1000 F is the development of the *Kraus Research Laboratories*, Sparks, Md. It is resistant to mild acids and has a hardness ranging between porcelain and organic finishes. It withstands impact and thermal shock well and may be heated to 1000 F and sub-



Unit and quench tank, having a capacity of 150 to 350 pounds of work per hour, heat treats screw drivers, chisels, small tools, and miscellaneous hardware. This installation at the plant of Cornwall and Patterson, Bridgeport, Conn. replaced five salt bath furnaces.

Two units, each having a capacity of 300 to 600 pounds of work per hour, normalize and harden various hand tools such as pliers, wrenches, hammers, etc. at the Peck, Stow, & Wilcox Co., Southington, Conn.

Tool Manufacturers Prefer
A.G.F. RECIPROCATING FURNACES
FOR THEIR PRODUCTION HEAT TREATING

The following are but a few of the many features that have caused leading manufacturers to choose A.G.F. Reciprocating, Controlled Atmosphere Furnaces for their heat treating departments:

VERSATILITY. Each furnace can be used without modification to process work ranging from extremely small, light springs, stampings, and drop forgings, etc. up to quite large and heavy pieces.

POSITIVE ATMOSPHERE CONTROL. The full muffle type Reciprocating Furnace has been redesigned to provide a 100% atmosphere seal. The new seal permits maintenance and duplication of any desired atmosphere to a degree not heretofore obtainable. *Surface restoration of decarburized work, case hardening by the patented "Ni-Carb" process, clean hardening, normalizing, and carburizing* can be accomplished with equal advantage.

SIMPLICITY. There is no complicated drive mechanism or conveyor belt maintenance problem. Only the work, advancing through the muffle by its own momentum, enters and leaves the furnace. The simple drive mechanism gives an infinite range of speed at which the work may be processed. The drive mechanism itself is located entirely out of the heat to reduce maintenance to a minimum.

ECONOMY. Increased production per man hour, long alloy life, and minimized maintenance produce a lower heat treating cost per unit of work treated.

Unit and quench tank, having a capacity of 35 to 75 pounds of work per hour, heat treating belt saw teeth and other parts at the Mall Tool Company, Chicago, Illinois.

For detailed literature covering Reciprocating Furnaces, write for Bulletin No. 810-AB or send coupon below.

AMERICAN GAS FURNACE CO

142 SPRING STREET

ELIZABETH · NEW JERSEY

Please send Bulletin No. 810-AB illustrating and describing Reciprocating Furnaces.

Name .....

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DURALOY

Articulated Tray

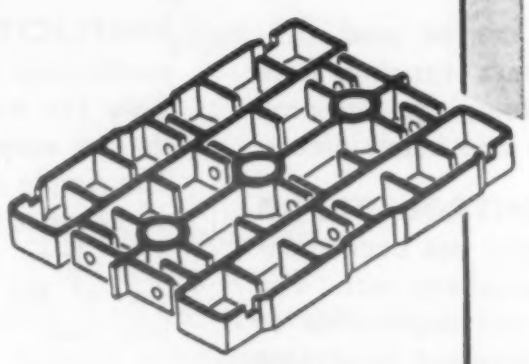
Corner-Cracking Overcome

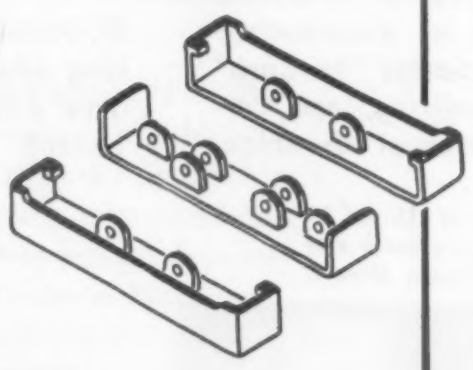
This is something relatively new and certainly considerably better than the conventional one piece tray.

1 . . . rigid corners have been eliminated

2 . . . lighter construction is permissible

3 . . . tray parts are replaceable





If you require heat-treating trays in your plant, why not investigate the Duraloy Articulated Tray*? The principle of design permits wide variations in size and shape. Send us a sketch or description of your present trays and we'll design a Duraloy Tray to take its place and let you know what it will cost.

If interested in high alloy castings generally, send for our Catalog 4729-G.

*Patented

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Los Angeles & San Francisco KILSBY & HARMON

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1-DU-3

New Materials and Equipment

merged in cold water repeatedly without crazing or peeling.

The coating can be applied to light gage metal without warping, due to its low

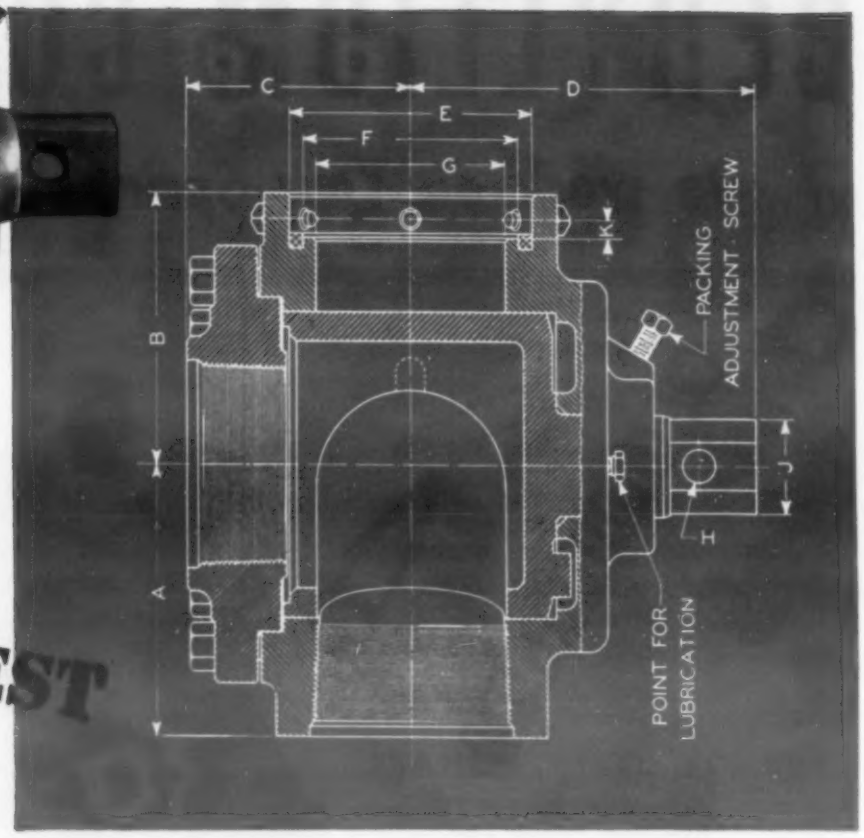
The strippable coating is easily removed by hand or blown off with compressed air.

curing range. It is available in many colors, ranging from white to black, and can be applied to aluminum, magnesium, glass, ceramic ware, asbestos shingles and many other materials. Some of its typical uses are coating gas or electric heaters, mufflers, outside lamps, metal shingles, aircraft heaters, steel coal cars and transformer cases.

New Welders Designed to Meet Range of Production Requirements

A new line of a.c. welders, with ratings from 100 to 2000 amp., is now in production by *Glenn-Roberts Co., Inc.*, 2107 Adams St., Indianapolis 18, Ind. Production welding requirements are covered by four models for manual welding, NEMA-rated at 200, 300, 400 and 500 amp. at 40 v., 60% duty cycle; 750 and 1000 single-transformer models for automatic-head welding; and 1000-, 1500- and 2000-amp. multiple-transformer models for combination manual-automatic use.

All models are equipped for dual-range output. Provision for installation of "built-in" equipment for inert gas arc welding has been made on all industrial models, which are also equipped for the use of optional remote control accessories. A feature is the heavy-duty design and construction of all models.



ACCEPTED AFTER TEST

ORBIT VALVE SELECTS Meehanite® Castings

Desirous of improving the dependability and service qualities of an oil well control head, Orbit Valve Company, Tulsa, Oklahoma conducted numerous pressure and property tests. As a result of these tests Meehanite castings are now specified.

The unit is used in conjunction with cable-type drilling tools for oil and gas well drilling-in and cleaning-out operation. Its purpose is to control pressure kick-back which sometimes occurs during these operations. While not considered a high-pressure unit, each body must withstand a 2000 psi hydro-static pressure test without any signs of seepage. In addition, smooth, uniform, dimensionally accurate and machinable castings are desired.

Meehanite castings regularly meet these requirements as a result of the many rigid controls of metal, melting and foundry practice applied in their manufacture.

Write for Meehanite Bulletin No. 10 "Meehanite —the Metal for Pressure Castings."

Meehanite®

MEEHANITE FOUNDRIES

American Brake Shoe Co.	Mahwah, New Jersey
The American Laundry Machinery Co.	Rochester, New York
Atlas Foundry Co.	Detroit, Michigan
Banner Iron Works	St. Louis, Missouri
Barnett Foundry & Machine Co.	Irvington, New Jersey
E. Long Ltd.	Orillia, Ontario
E. W. Bliss Co.	Hastings, Mich. and Toledo, O.
H. W. Butterworth & Sons Co.	Bethayres, Pennsylvania
Continental Gin Co.	Birmingham, Alabama
The Cooper-Bessemer Corp.	Mt. Vernon, Ohio and Grove City, Pa.
Crawford & Doherty Foundry Co.	Portland, Oregon
Farrel-Birmingham Co., Inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co.	Florence, New Jersey
Fulton Foundry & Machine Co., Inc.	Cleveland, Ohio
General Foundry & Manufacturing Co.	Flint, Michigan
Greenlee Foundry Co.	Chicago, Illinois
The Hamilton Foundry & Machine Co.	Hamilton, Ohio
The Henry Perkins Co.	Bridgewater, Massachusetts
Johnstone Foundries, Inc.	Grove City, Pennsylvania
Kanawha Manufacturing Co.	Charleston, West Virginia
Koehring Co.	Milwaukee, Wisconsin
Lincoln Foundry Corp.	Los Angeles, California
Otis-Fensom Elevator Co., Ltd.	Hamilton, Ontario
Pohlman Foundry Co., Inc.	Buffalo, New York
Rosedale Foundry & Machine Co.	Pittsburgh, Pennsylvania
Ross-Meehan Foundries	Chattanooga, Tennessee
Shenango-Penn Mold Co.	Dover, Ohio
Sonith Industries, Inc.	Indianapolis, Ind.
Standard Foundry Co.	Worcester, Massachusetts
The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
U. S. Challenge Co.	Centerville, Iowa and Batavia, Illinois
Valley Iron Works, Inc.	St. Paul, Minnesota
Vulcan Foundry Co.	Oakland, California
Warren Foundry & Pipe Corporation	Phillipsburg, New Jersey

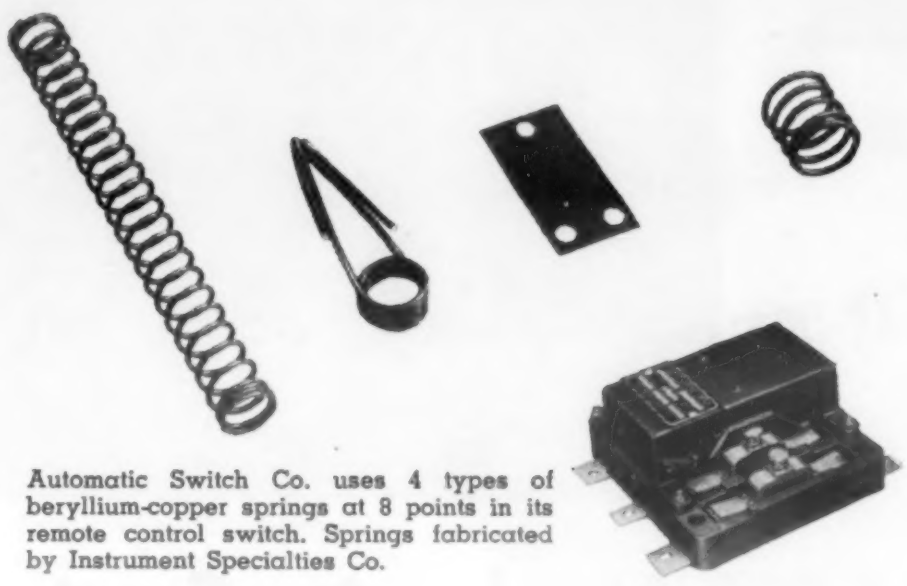
"This advertisement sponsored by foundries listed above."

PERSHING SQUARE BUILDING • NEW ROCHELLE, N. Y.

Put High Performance

BERYLLIUM-COPPER

to work on Your Spring Problem



Automatic Switch Co. uses 4 types of beryllium-copper springs at 8 points in its remote control switch. Springs fabricated by Instrument Specialties Co.

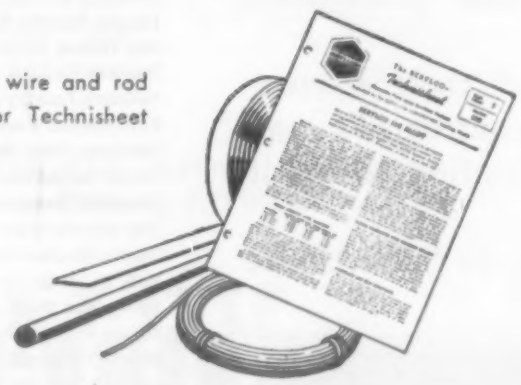
By taking advantage of the special properties of BERYLCO 25S, The Automatic Switch Company has built high efficiency into remote control switches while cutting assembly costs.

4 Springs . . . . . 4 Functions

- *LONG CORE SPRING* . . . Non-magnetic for operation in solenoid field and corrosion-resistant for out-door installation.
- *SHORT COMPRESSION SPRING* . . . Maintains desired contact pressure without set at high temperatures.
- *TORSION SPRING* . . . High strength for maximum operating power.
- *FLAT SPRING* . . . Dimensional control through fixture heat-treatment gives accurate positioning of arcing contacts.

If, in addition, your spring problem involves freedom from drift, electrical conductivity or close control of free length, coil diameter and load-deflection rate—look to beryllium-copper for the solution.

BERYLCO 25S is available in strip, wire and rod forms. For specific data, write for Technisheet No. 2.



BERYLCO BERYLLIUM

The **BERYLLIUM CORPORATION**

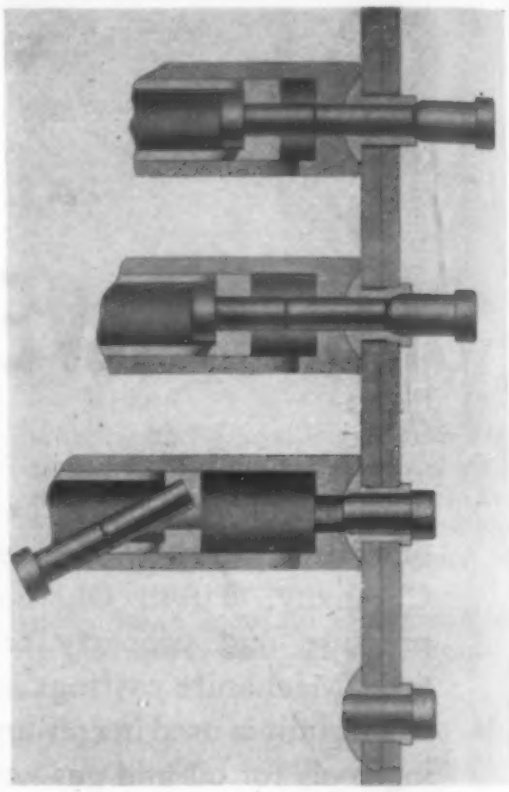
Dept. 2M, Reading 3, Pa.

New Materials and Equipment

New Rivet Saves One Installation Step

Self-plugging rivets, which can be installed as fast as the hollow-type rivet, have been developed by the *Cherry Rivet Co.*, 231 Winston St., Los Angeles 13, Calif. The most important feature of the rivet is that the stem fractures flush with the rivet head.

The new rivet is of A17ST aluminum alloy and compares favorably in strength



The four cross-sections show how the rivet is installed.

to solid rivets of the same material, except for a slight reduction in strength when used in thin sheets. For higher sheer strength, the rivets can be manufactured from 24ST aluminum alloy; the stems in either case are 17ST.

The primary advantage of the rivet is said to be that of saving time on production lines. The speed of installation of the flush-fracturing rivet makes it suitable to many assembly processes where rivets are not presently in use. This new rivet does not replace the standard self-plugging rivet manufactured by this company. It is primarily designed for applications where high tensile loads are not a factor.

New Developments in Presses

Tilting-Head Hydraulic Press

Tilting-head hydraulic presses of new design are available from *Emmett Machine & Manufacturing, Inc.*, 2249-9 14 St., Akron

new and **important** to you

Here are the advantages to you of Lebanon's new **CENTRI-DIE** casting process—

1. Greater density, resulting in enhanced physical properties.
2. Production of assorted parts and shapes not practicable by static methods.
3. Uniform strength throughout, as no flow lines exist.
4. Production of alloys, difficult or impossible to forge.

LEBANON STEEL FOUNDRY
LEBANON, PA.
"In the Lebanon Valley"

Send for this FREE Bulletin

Write on your business letterhead or fill in this convenient coupon and we will send you a copy of the Bulletin **"CENTRI-DIE CASTINGS".**

CONTENTS

Centrifugal Casting in Permanent Molds
Advantages of Centrifugal Casting
Various Methods Now Employed
1. True Centrifugal Casting
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Applications of new **CENTRI-DIE** Method
Finishing Procedures
Inspection Methods
New **CENTRI-DIE** Equipment at Lebanon Steel Foundry
General Type Compositions Adaptable to **CENTRI-DIE** Production

Lebanon Steel Foundry
Lebanon, Pa.

Please send me a copy of your Bulletin H describing the NEW CENTRI-DIE Process of centrifugal casting.

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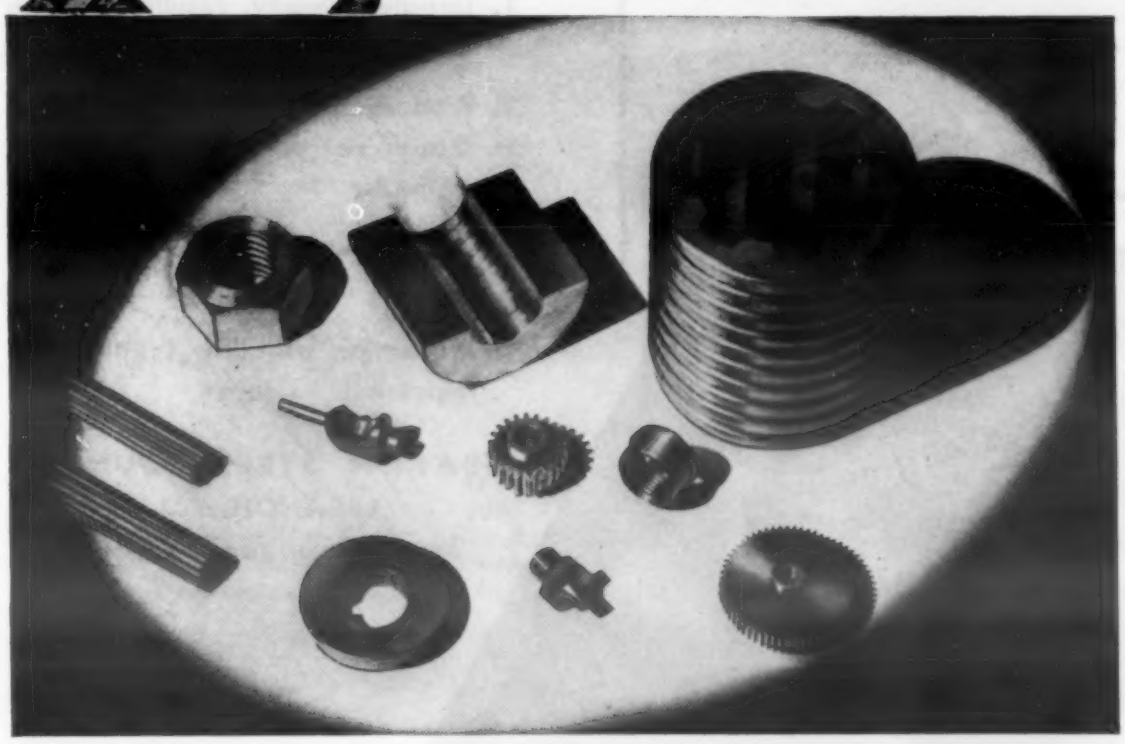
LEBANON *ALLOY AND STEEL* Castings
CIRCLE L

OFFERS A
COMPLETE RANGE
OF
PHOSPHOR BRONZE
RODS
for EVERY need



Nowhere else have you a choice of such a wide range of alloys, sizes, finishes, machining properties, and resistance to wear and corrosion. Phosphor Bronze Corporation offers a practically *unlimited* choice for any job—whether it calls for peak strength and hardness, highest ductility and toughness, or for best machinability.

COMPLETE RANGE OF ANALYSES, TEMPERS, FINISHES

(1) Choose from 7 *non-leaded wrought alloys in many* tempers and 4 different finishes—with tin content from 1% to 10%.

(2) Choose from *5 leaded wrought alloys* for up to 95% relative machinability —choice of tempers and finishes with lead content up to 5%.

(3) Choose from *13 standard chill-cast and turned* alloys—with tin content from 5% to 18½%; lead from 0% to 10%.

WIDEST SIZE RANGE

(1) Wrought alloys from .010″ to 4¾″ diameter in lengths of 6 to 12 feet.

(2) Chill-cast and turned rods from ½″ to 6″ diameter.

NOTE: Chill-cast and turned rods are 3 to 6 feet long as compared with 12 to 13 inches usually available. A real saving in set up time and run-outs.

As specialists in Phosphor Bronze, ELEPHANT BRAND blankets the field—for standard or special products. This is your assurance of highest quality and widest selection. Specify ELEPHANT BRAND—truly "the first name in Phosphor Bronze".

The Rod Section of the ELEPHANT BRAND Technical Data Book gives detailed information on the complete rod line. Sheet, wire, rope, and castings are also covered in this fileworthy addition to your reference library.

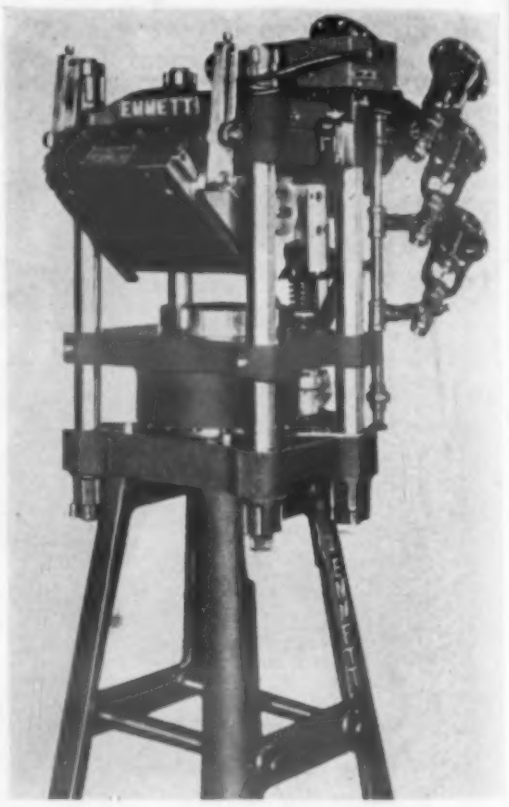
Elephant Brand
First name in PHOSPHOR BRONZE

THE PHOSPHOR BRONZE CORPORATION
Dept. B—2200 Washington Avenue, Phila. 46, Pa.

New Materials and Equipment

14, Ohio. One of the new models, No. E-113, shown in the accompanying illustration, is available in two sizes having platens of either 14 by 14 in. or 24 by 24 in. They have been designed for applications requiring high-speed operation, accuracy of mold register, convenience of loading, and ease of stripping molded products from press.

Construction features include bronze bushing guides on lower platen; annealed steel



One of the new models of a new line of tilting-head hydraulic presses.

ram, cylinder and head castings; and self-contained packing cartridge which can be removed for replacement or maintenance.

Operating speed of the press is 3 sec., including opening or closing of mold and tilting of head. The small press is stressed for a maximum pressure of 3000 psi. and the large press for a pressure of 2500 psi. Pull-back operation is accomplished by means of a telescopic ram located inside the main ram. Normal stroke is 2½ or 6 in. in the 14 by 14 size, and 8 in. in the 24 by 24 size.

Single Action Press

A recent development for deep drawing and forming of sheet metal is this new 100-ton single action press built by the *Hydraulic Press Mfg. Co.*, Mount Gilead, Ohio. It is an all-hydraulic, self-contained unit with a 48- by 36-in. platen, 30-in. daylight and an 18-in. main ram travel. Located in the press bed is a 33-ton hydraulic die cushion with a 32- by 25-in. platen and 7-in. stroke.

The press closes and opens at a rate of 770 in. per min. It automatically reverses at a predetermined setting and slows down

A Big Step Forward!

ALL-METAL
CHROMALOX
Electric
RADIANT HEATERS

A New Infrared Heat Source

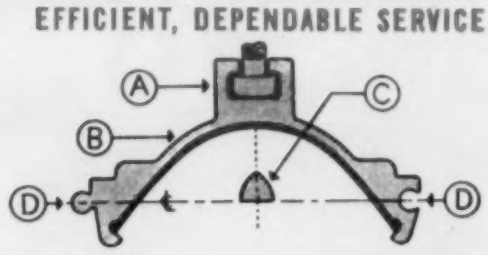
Now—You can use infrared heat in many applications where it has not been entirely practical before. That's because the new, all-metal CHROMALOX Radiant Heaters withstand shock, vibration, dust and moisture . . . they provide glareless infrared radiation in wave lengths which are absorbed almost equally well by all colors, textures and surfaces . . . they operate efficiently in high and low ambient temperatures.

FLEXIBLE IN APPLICATION—CHROMALOX Radiant Heaters are used for infrared drying, preheating, baking, curing, mass-heating, skin-drying, dehydrating and similar applications. Tongued-and-grooved sides facilitate fabrication of heater sections into various working patterns such as banks, tunnels, ovens, etc.

HIGH IN EFFICIENCY—The heat source is an efficient Inconel-sheathed CHROMALOX Tubular element which operates at temperatures of 1000° to 1400° F. It produces uniform and even heat without hot-spots and with a negligible amount of incandescent light. "Alzaked" aluminum reflector sheet gives maximum radiation.

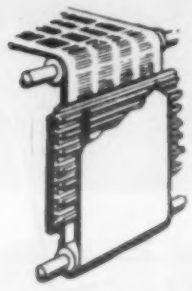
GLASSLESS, ALL-METAL CONSTRUCTION—Extruded aluminum body and shock-proof heating element withstand rough usage; dangers of glass breakage are eliminated. Compact size —4" depth with lengths of 25", 31" and 47". Units come complete with adjustable mounting bolts, ready to install.

QUICK, LOW COST INSTALLATION
EFFICIENT, DEPENDABLE SERVICE

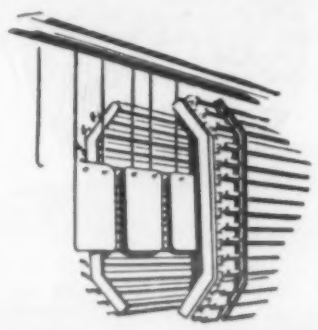


A. Two adjustable captive-bolts per section permit quick and easy mounting into desired position.
B. Extruded aluminum body is equipped with a highly polished, non-oxidizing parabolic reflector for maximum reflectivity.
C. Heat source is high temperature Chromalox triangular-shaped element located to give efficient direct and reflected radiation.
D. Units can be quickly interlocked lengthwise to form straight lines and circular or oval banks of any desired width.

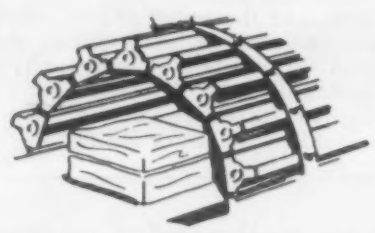
TYPICAL APPLICATIONS:



Single-banks of Chromalox Heaters, mounted in line, bring the efficiency of infrared heat to applications where it was not practical heretofore because of space limitations.



Easily formed, double-banks of Chromalox Radiant Heaters are ideal for line-production. Infrared rays are radiated directly and uniformly on materials being processed.



Sections may be interlocked to form tunnels over conveyor belts; units operate with equal efficiency from all angles. Their glassless construction permits their use in processes and assembly lines which formerly avoided infrared heat because of the hazards of open flames or glass breakage and contamination.

CHROMALOX

Electric Heat for Modern Industry

EDWIN L. WIEGAND CO. · 7523 THOMAS BLVD., PITTSBURGH 8, PA.

Write for Free Bulletin CS-603

It contains complete information and specifications on the all-metal Chromalox Electric Radiant Heaters and shows how you can use these units in your present or projected infrared applications.

This Kennametal Style 11H90 Tool turns five of these semi-steel cast-iron cylinder liners compared to one with the carbide tool formerly used.

It takes a hard, strong, sound tool material to remove 4,500 cubic inches of metal from five of these semi-steel cast-iron cylinder liners before regrinding—and then to repeat the performance after each resharpening, over the entire life of the tool.

* Consistent soundness and uniformity of structure characterize all Kennametal compositions, as illustrated in the micrograph above (1500 times enlargement). Note absence of large grains, and virtual freedom from porosity.

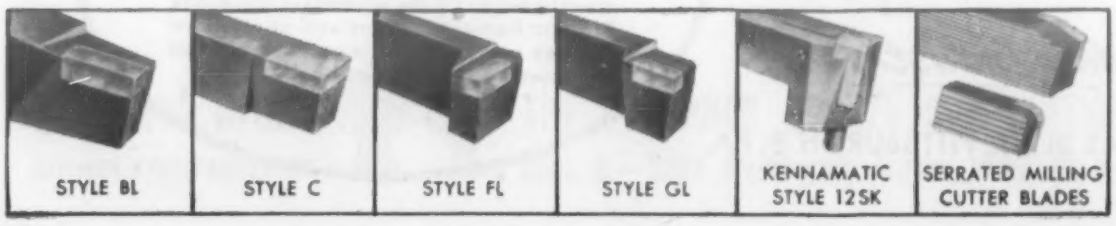
All Kennametal compositions are much harder than the hardest tool steel, and the uniformity of hardness and strength of each grade comes from a consistently sound physical structure which is produced by distinctive processing, and precise, scientific methods of control.

The proof of the pudding is in the eating—service results prove that a carbide which gives superior service is that having uniform grain structure, and therefore consistently maintained hardness, strength, and wear-resistance. That's Kennametal.

Equally important in cutting machining costs are Kennametal developments in mechanically-held tooling which further extend the profitable use and low-cost maintenance of carbide tooling. Kennametal tooling is completely-proved—can save money on 90% of your routine and unusual jobs. Ask our district engineer to demonstrate.

KENNAMETAL Inc.®
LATROBE, PA.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTION



New Materials and Equipment

prior to die contact. Pressing speed under full load is 146 in. per min. Operating on a 12-in. working stroke and building up 100 tons pressure on a solid surface, this press will cycle approximately 20 times per min. Maximum pressure can be obtained at any point within the limits of the ram stroke. Both speed and pressure are easily adjusted.

Three methods of operation are provided:

This frame of the single action press is a combination of castings and weldments.

manual, semi-automatic or full automatic. Change-over from one method of operation to another is quickly made by the operator at the electric control station.

Straight Side Presses

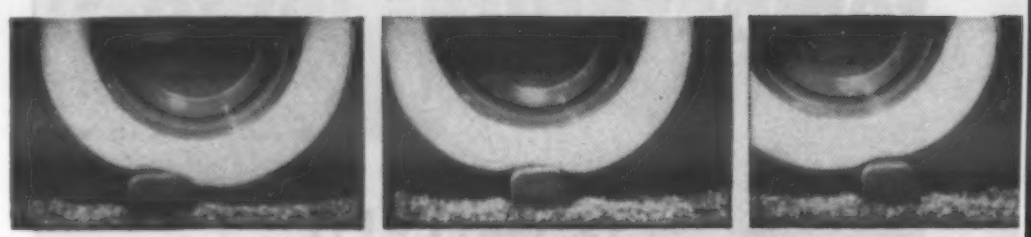
The *Niagara Machine & Tool Works*, 637-697 Northland Ave., Buffalo, N. Y., has recently completed several newly designed, all welded, straight side presses, both the single and double crank variety. The machine illustrated, typical of this new line, is a double crank single geared tie rod frame press having a rated capacity near bottom stroke of 185 tons. With both single and double geared machines the high-speed shaft and flywheel with electro-pneumatic clutch is mounted within the crown above the crankshaft.

Bearings on each side of the backshaft pinion prevents shaft deflection. The deep bed, slide and crown are said to minimize deflection, and the welded construction permits a flexibility in dimensions to suit individual requirements.

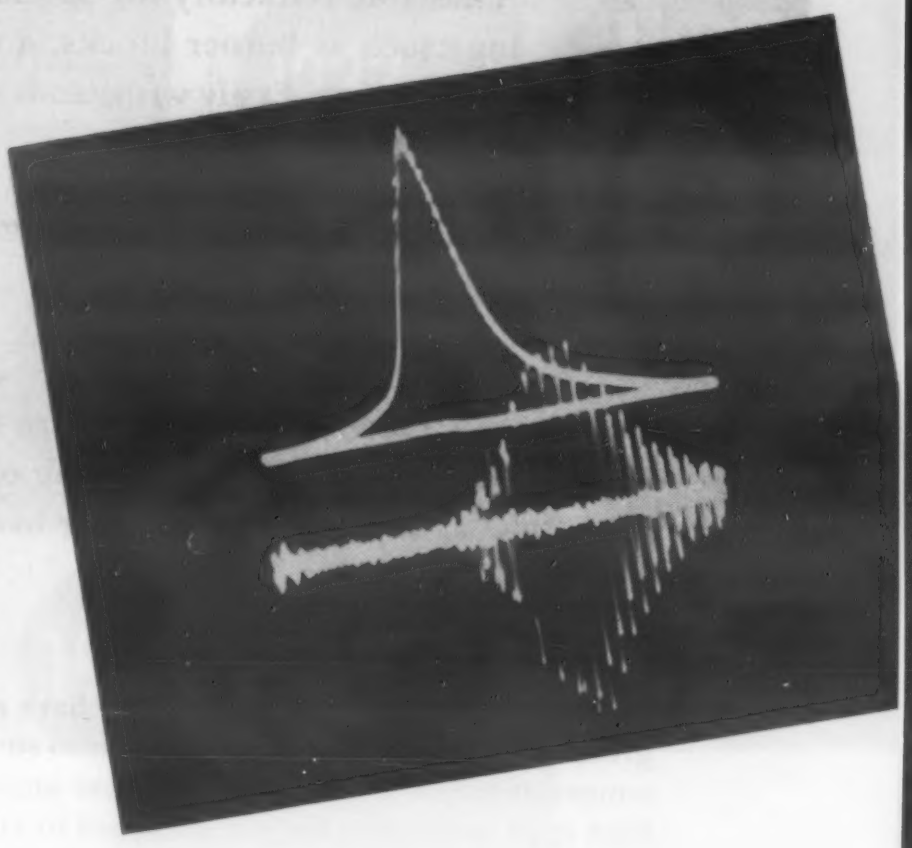
Use of the five-way clutch control is optional on any of these machines equipped with electro-pneumatic friction clutch. With

3 WAYS PHOTOGRAPHY STOPS TIME

1. HIGH SPEED STILLS—taken as fast as a millionth of a second—give sharpest possible detail of an instant of motion. Recording these calls for the greatest photographic sensitivity or "speed"—speed such as is found in the fastest of Kodak sheet films, Kodak Super Panchro-Press, Sports Type. In the illustration (1/100,000 second), spray from a lacquer gun is "stopped" to study dispersion of material.



2. HIGH SPEED MOVIES—slow down action far too fast to see otherwise—can expand 1 second of motion into 4 minutes of viewing time. For this the extremely fast, fine-grained Cine-Kodak Super-XX Panchromatic Film is specially spooled for high-speed cameras. The three frames in the illustration are from a high-speed film showing the action of a tire striking an obstacle at high speed.



3. RECORDING OSCILLOGRAPH TRACES—to record high-speed action translated into cathode ray oscillograph patterns, there are the extremely fast Kodak Linagraph Pan Film for blue-emitting screens and Kodak Linagraph Ortho Film for green-emitting screens. These are spooled for still cameras and high-speed movie cameras. Also for cathode tube traces, there is Kodak Linagraph 1127 Paper. For moving mirror oscillographs there is Kodak Linagraph 697 Paper. These papers have a smooth luster surface that takes pen or pencil notations readily. In the illustration the upper trace represents the pressure of detonation in the cylinder of a knocking gasoline engine—the vibrations in the lower trace have a period of about 1/100,000 second.

FUNCTIONAL PHOTOGRAPHY

. . . is advancing scientific technics

Should you have any questions on photographic materials used in high-speed studies—or in any other branch of scientific or industrial photography, we shall be glad to have you write us.

EASTMAN KODAK COMPANY
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Kodak

Announcing... 2 new

J-M refractories for temperatures up to 3000 F.

new

3X FIRECRETE*

A castable refractory for special shapes and linings such as burner blocks, door linings, forge furnaces, etc. Easily withstands soaking temperatures of 3000 F.

new

3X BLAZECRETE

A refractory gunning mixture for building new furnace linings and repairing old ones. Can also be applied by troweling for heavy patching.

Both of the above new refractories have negligible shrinkage from application time to soaking temperatures of 3000 F. Both possess unusually high spall resistance. Each is furnished in 100-lb. bags. See your authorized distributor for further information, or write to Johns-Manville, Box 290, New York 16, N.Y. **Reg. U. S. Pat. Off.*

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville FIRECRETE
The Standard in Castables

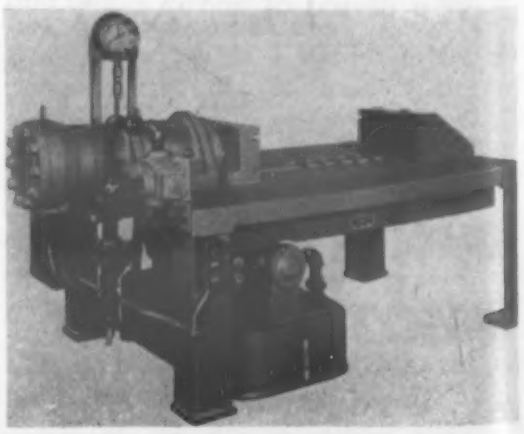
New Materials and Equipment

Rated capacity of this straight side press is 185 tons.

this device it is possible, by setting a selector switch, to operate the press with front and rear buttons, with front buttons alone, rear buttons alone, continuously or by jogging when setting the tools.

Bending and Straightening Presses

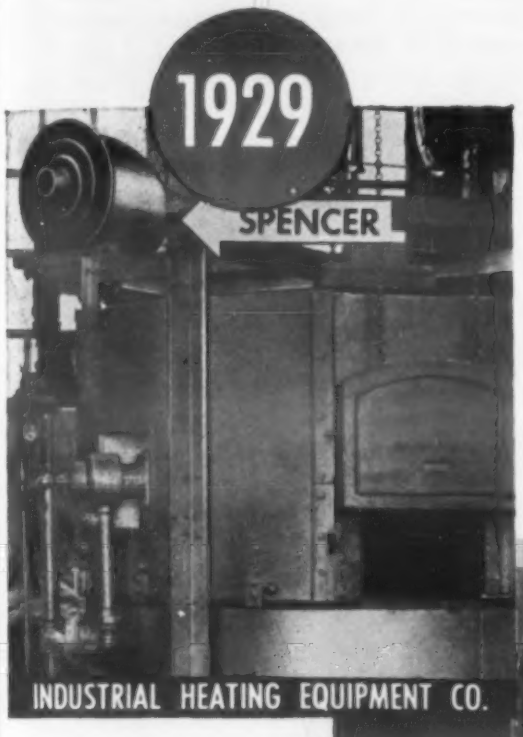
A self-contained, 30-ton bending press has been designed by the *R. D. Wood Co.*, 402 Chestnut St., Philadelphia, Pa., for general shop work use in bending and straightening bars, rods, light structural sections, and similar material. It has application for the variety of work found in maintenance or machine shops, railroad repair shops, structural shops, electrical departments, and allied activities. Weighing approximately 6000 lb., this press is provided with a smooth tool finish work table 3 by 4 ft. The size of ram head and resistance head is 9 by 18 in., and increments of 4 in., from a minimum of 12 in. to a maximum of 36 in., are used for

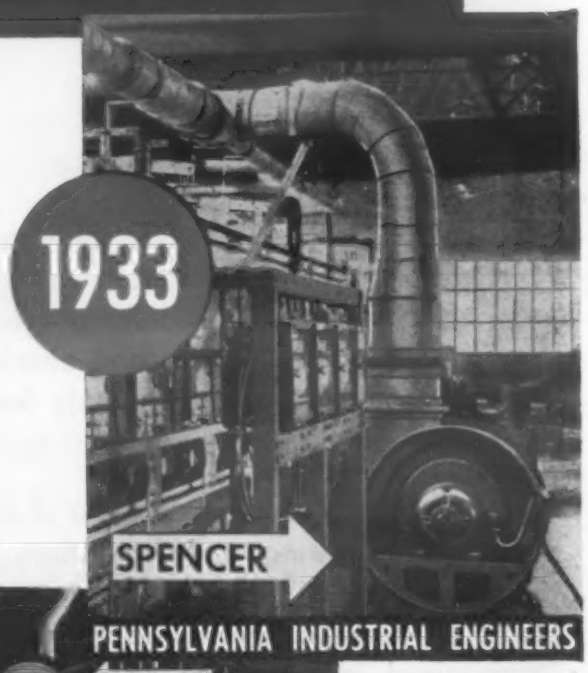


Horizontal hydraulic bending presses such as this are used in general shop work.

Since 1921

The first Spencer Turbo was installed in 1917. Many of the early machines are still in service. A few of the equipment manufacturers that have used Spencers consistently (see dates) for many years are represented on this page.





Standard sizes from 35 to 20,000 cu. ft.; 1/3 to 800 H.P.; 8 oz. to 10 lbs. Single or multi-stage, two or four bearing. Special gas-tight and non-corrosive consruction available.

Special Spencer Bulletins are available as follows: Data, No. 107, Gas Boosters, No. 109, Four Bearing, No. 110, Blast Gates, No. 122, Foundries, No. 112 and the General Bulletin is No. 126.

359-B

SPENCER HARTFORD

THE SPENCER TURBINE COMPANY • HARTFORD 6, CONN.

TURBO-COMPRESSORS

Whose Responsibility is SURFACE FINISH?

FIT AND FINISH are twin requirements for economical manufacture. To assure interchangeability of parts, the *fit* (i.e., size and tolerance) has properly been specified by engineering departments for many decades; but how about *finish?*

Until 20 years ago, surface finish could not be numerically specified or measured. Thus it was commonly left to the shop to provide a suitable finish. Inevitably there was no definite knowledge of the finish required for best performance of the product; and there was little regard on management's part for the methods and cost of obtaining the finish. Furthermore, since finish could not be measured numerically, this procedure often led to differences of opinion between everyone concerned, requiring costly executive time to decide on the acceptability of the finishes produced.

Since about ten years ago, when practical means became available for *measuring* surface roughness, hundreds of plants have studied the effects of finish on both product quality and production costs. These plants now specify and check the microinch finish on many surfaces, and get better products faster and at lower cost thereby—often with fewer operations.

To obtain these advantages, it is necessary to *specify* surface finish on working drawings and shop prints. The logical source of such specifications is the department which decides on *dimensional* specifications—namely, the engineering department. Once established and maintained in the shop, surface specifications result in substantial savings.

For checking surfaces in the shop, the Profilometer is ideal. It measures quickly, accurately, in definite microinch units, on practically all machined, ground and finished surfaces. May we give you complete information?

***Profilometer* is a registered trade name.**

A SURFACE CONTROL INSTRUMENT BY

PHYSICISTS RESEARCH COMPANY

ANN ARBOR • MICHIGAN

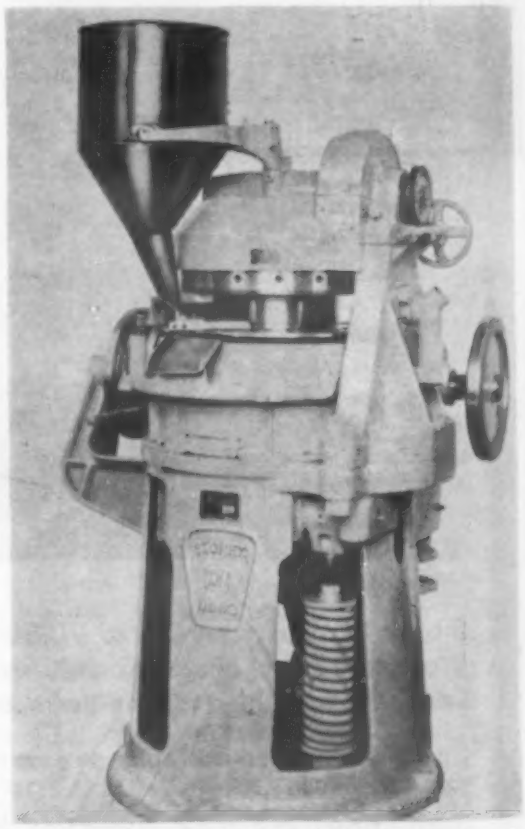
New Materials and Equipment

adjusting distances between these heads. Some installations use the press mounted on end, as a vertical moving down-type press. This position allows the press to be used with forms to make pipe conduit hangers, and for similar work.

An open gap type press available in various sizes and capacities also has been announced by the same company for use in bending, flanging or straightening operations. The sizes of the table and ram head of the 250-ton size are 30 by 30 in., and 8 by 6 in., respectively. Operating hydraulic pressure is supplied by a 2000-psi. two-stage rotary vane type pump displacing 17.7 gpm. This press, furnished complete with protective devices, safety valves, pressure gage and all necessary valves and control equipment, is simply controlled by a single four-way operating valve connected by linkage to twin control levers mounted on opposite sides of the press.

Cold Molding Plastic Press

An automatic, 15-ton capacity, rotary type press for cold molding of a wide variety of parts is available from the *F. J. Stokes Machine Co.*, 5972 Tabor Rd., Philadelphia, Pa. This press is equipped to prevent jamming and undue strain on the machine and punches, in the event of an overload. With full pressure, applied from above and below, all cold molded parts are said to be of high and uniform density. Adjustments for pressure, thickness of the piece, and speed of press can be made during press operation.



This rotary type cold molding press is suitable for high production work.

Shouldered, flanged, and other parts re-

It's LOFTUS...
All along the Line
Furnaces for every Heat-Treating Operation . . . .
Loftus Engineers, Designs and Constructs complete plants and individual furnaces.
Every step along the way — From the Open Hearth to the Heat-Treating Line — The Loftus organization serves the metallurgical field from melting and refining to the finished heat-treating product.
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No Imperfections!

USE SUPERIOR FOR DIESEL FUEL INJECTION TUBING

A sample six-inch length of this diesel fuel injection tubing will be sent upon request on your company letterhead.

Superior cold drawing processes limit seams, laps, pits and slivers to the absolute attainable minimum—for fuel injection tubing with its highly critical operating pressures and endurance requirements the finishes of the tubing must be flawless—must have uniform, clean surfaces.

Close production and laboratory control, selection of raw stock billets, microscopic inspection of material in process and at finish, exact furnace atmospheric and temperature control, these are the Superior procedures that assure clean, bright, dead soft tubing.

Superior tubing is cold drawn to customer specifications, no "standard" sizes are carried in mill stock. Available in random, multiple or cut lengths, to American Bosch or your specifications, this fuel injection tubing is bound to do a better job.

We invite your request for further information.

Superior

THE BIG NAME IN SMALL TUBING (.010" TO 5/8" O.D. MAX.)

SUPERIOR TUBE COMPANY

2006 Germantown Avenue, Norristown, Pa.

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New Materials and Equipment

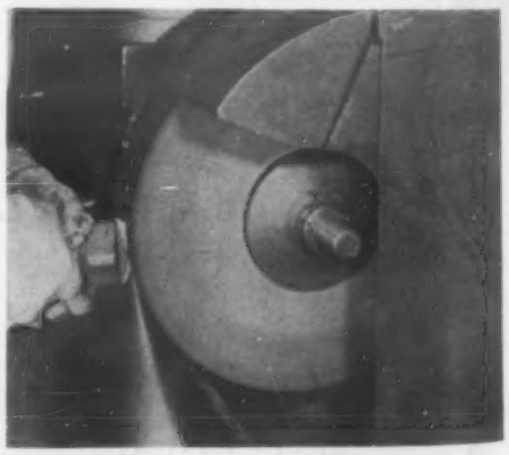
quiring different levels of compression are said to produce at high speed, with minimum operator attention. Where holes or perforations are required in the part, a core rod attachment can be furnished. This cold molding press will take pieces up to a maximum diameter of 1 7/16 in. and maximum die fill of 2 1/16 in.

Contact Wheel Designed for Heavy Grinding and High Speeds

A new contact wheel for heavy grinding with abrasive belts at speeds of 10,000 surface ft. per min. or more has been announced by the *Minnesota Mining & Manufacturing Co.*, 900 Fauquier Ave., St. Paul, Minn. Major advantages reported for belt grinding with the new roll are faster and cooler stock removal, lower production cost, and chatter-free grinding.

The combination of the high speed and the new wheel design enables abrasive belts to remove heavy metal stock faster, to perform better-finished snagging, and to eliminate frictional heat problems.

In preliminary tests the new wheel has proven valuable in heavy stock removal, such as grinding gates and flashings on



A piece of heavy stock being ground on the new contact wheel.

castings, cutting down welds and grinding through scale on forgings.

The wheel is made in 8- and 16-in. dia., in face widths of 2, 3, 4 and 6 in. It is designed for use with cloth belts coated with silicon carbide or aluminum oxide mineral grains.

Reduction of grinding heat, accomplished by the design of this wheel, lengthens belt life in two ways on most heavy stock removal operations: (1) Loading and glazing of the belt are minimized; (2) high speeds increase the amount of cutting surface which contacts the metal per second.

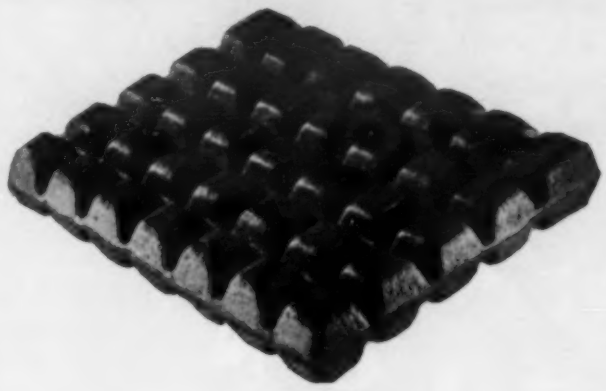
Steel-Weld FABRICATION

These Steel-Weld Fabricated heavy machine parts are typical of work turned out in the Mahon plant for many customers representative of a cross section of heavy industry in the United States. You also, will find the Mahon Company an excellent source for welded Steel in any form . . . a source equipped to provide complete machining service on any welded steel products or parts. Mahon's staff of design engineering experts, backed by craftsmen highly skilled in the latest techniques in the welding art, are your assurance of a better, smoother appearing job embodying every advantage of Steel-Weld Fabrication.

THE R. C. MAHON COMPANY
DETROIT 11, MICHIGAN

Engineers and Fabricators of Welded Steel Machine Bases and Frames, and Many Other Welded Steel Products

MAHON



A Little Does a Lot

GCC CERIUM METAL (Mischmetal) added in small quantities to many Ferrous and Non-Ferrous Metals improves the metallurgical and mechanical properties of the end products.

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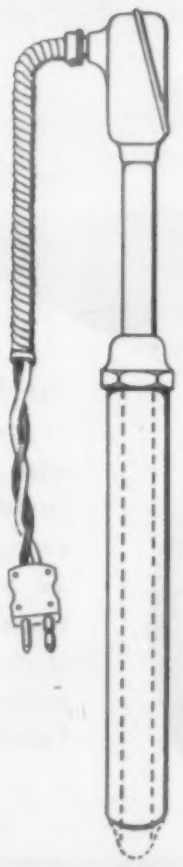
EDGEWATER, NEW JERSEY

THERMOCOUPLES
for
Difficult Applications

More and more we are called upon to furnish thermocouple equipment for difficult or unusual applications. We are frequently asked to supply thermocouple assemblies that will withstand the rapid corrosive action of various gases and molten metals. Our recommendations for such installations have proven highly successful in obtaining longer thermocouple life, yet maintaining, and in some instances increasing, thermocouple sensitivity.

You, too, may have difficult applications. Consult us when you need Thermocouples, Quick Coupling Connectors, Connector Panels, Thermocouple Wire, Lead Wire, Protection Tubes, etc.

Write for your copy of our 34 page catalog, Reference G



Thermo ELECTRIC CO.
FAIR LAWN, N.J.

New Materials and Equipment

Machine Automatically Checks and Segregates Piston Pins

Piston pins are checked for average diameter and automatically segregated into six classifications by a new machine developed by the *Sheffield Corp.*, Dayton 1, Ohio. It is now installed in the plant of a large automobile manufacturer.

Pins are manually loaded into a chute which has a "No-Go" gaging fixture to prevent oversize parts from being accepted.

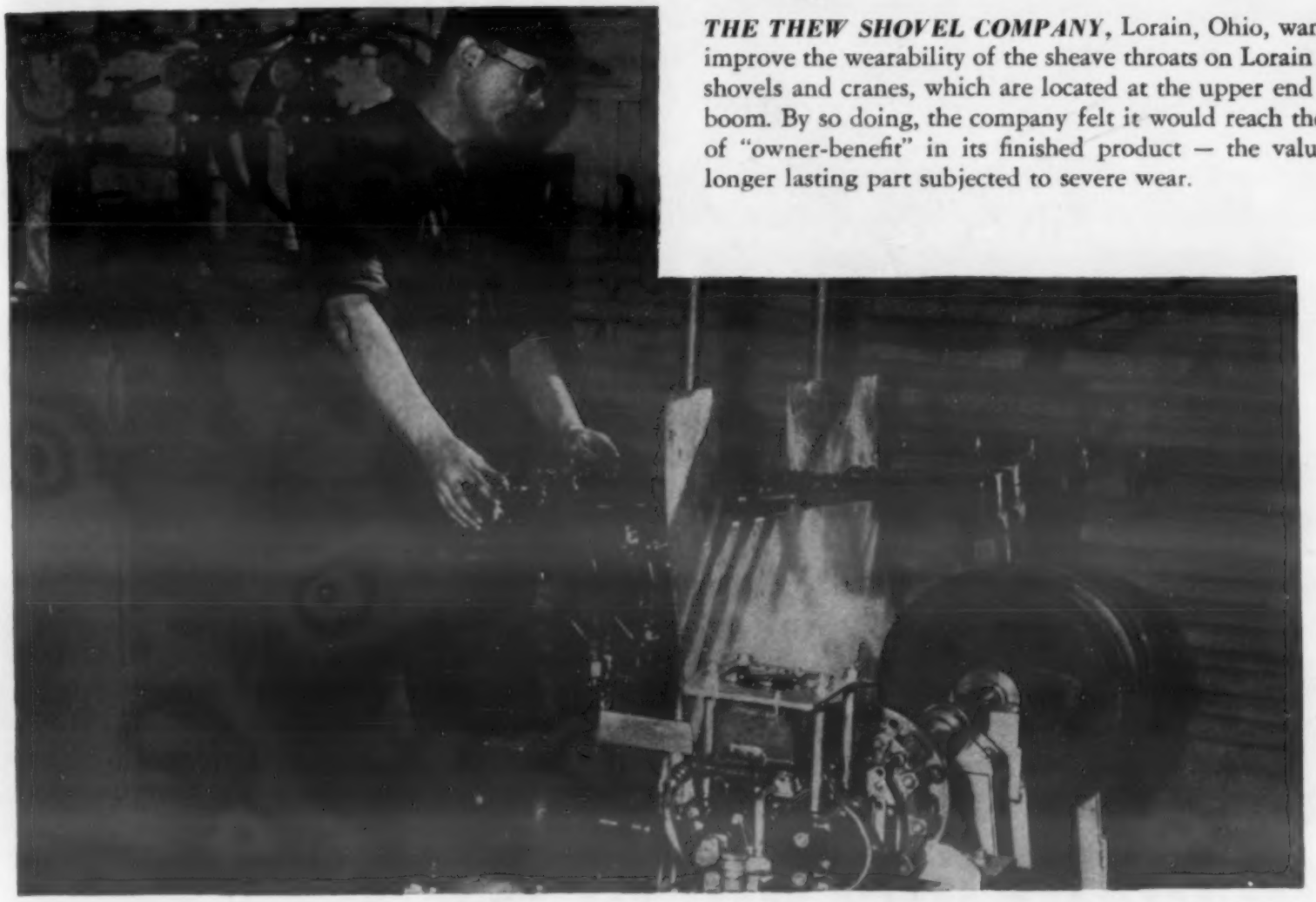
After manually loaded, piston pins are fed by gravity through the machine and segregated into six classifications.

The remaining parts are gravity fed into a locating "V" where a motor driven arm progresses a part into an air ring. After it comes to rest, it is checked by jets mounted in the ring which operate "Air-lectric" heads. These, in turn, actuate solenoids which open and close trip doors to the segregating chutes. The pin is then pushed through the air ring by the next piston pin to be checked, and is carried along by the traveling mechanism until it reaches its proper trap. Production segregating rate is approximately 2400 pins per hr.

Shear Utilizes Rapid Shearing Principle

An all-purpose cutting machine for general shop use has been developed by *Elge Associates*, 16 E. 71 St., New York 21. The new shear utilizes the principle of successive, fast shearing actions which, the company claims, produces a continuous cut with a finished and burr-free edge. The

Product "customer-value" built up with flame hardening



THE THEW SHOVEL COMPANY, Lorain, Ohio, wanted to improve the wearability of the sheave throats on Lorain power shovels and cranes, which are located at the upper end of the boom. By so doing, the company felt it would reach the acme of "owner-benefit" in its finished product — the value of a longer lasting part subjected to severe wear.

A. B. Neiman, Airco Technical Sales Representative, recommended oxyacetylene flame hardening. With this modern process, hardening could be localized to the sheave throat, *without* affecting the balance of the sheave's ductility. This was highly important for finished machining. Using a set-up of three Airco No. 4383 torches, with hardening tips especially designed for this job, three sheaves are simultaneously hardened to a predetermined degree that insures maximum wear-resistant qualities.

Since flame hardening was introduced, the company still has gone further in its efforts to increase the customer-value of its products by expanding this modern, localized hardening process to include: gears, jaw clutches, and other parts requiring longer "in-service" life.

• • •

TECHNICAL SALES SERVICE — ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

To assure its customers of high efficiency in all applications of the oxyacetylene flame or electric arc, Air Reduction makes available the broad, practical experience of its nationwide Technical Sales Division personnel. The collective experience and knowledge of these specialists has helped thousands to a more effective use of Airco processes and products. Ask about this Airco "Plus-Value" service today. Write your nearest Airco office. (In Texas: Magnolia Airco Gas Products Company . . . On West Coast: Air Reduction Pacific Company)

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Headquarters for Oxygen, Acetylene and other Gases... Carbide... Gas Welding and Cutting Machines, Apparatus and Supplies... Arc Welders, Electrodes and Accessories

Producers of

Metal Powders

Copper Powder
(ELECTROLYTIC GRADE)

Solder Powder

Silver Powder

Tin Powder

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STANDARDIZE

SAVE MONEY

Step up production—bring costs in your shop down—with solder pre-forms. Pre-formed rings, washers, pellets, discs, etc., made to your order, insure better bonds, lower costs, and faster assembly. We can supply you with custom-made pre-forms of any shape required, in a wide variety of solders, copper and brazing alloys.

Write for complete information.

Soldering Specialties

Dept. E, Summit, N. J.

New Materials and Equipment

shear will cut any material within its capacity such as fibre, brass, expanded metals, metal screen, stainless steel and paper products.

Material is not punched, but is sheared; the lower tool remains stationary while the upper tool, which is spring loaded, reciprocates vertically. Cutting speeds of 10 to 40 ft. per min. are possible, depending on the material.

For cutting irregular shapes and small circles, curved tools are used. Circles as small as 9 in. in dia. may be cut. For straight edges and large circles and curves, straight tools are used.

The overall dimensions are: 66 in. high, 24 in. wide and 86 in. long. Cutting edge to floor is 42 in. and throat depth is 51½ in.

Fatigue Machine Tests Pipe and Tubing

A rotating beam fatigue machine of 1,200,000-in.-lb. capacity has been built by the *Baldwin Locomotive Works*, Philadelphia 42, for testing pipe and tubing. Reflecting a trend toward the testing of actual industrial equipment in addition to standard test specimens of materials, the machine will be used for fatigue testing pipe spans of 2 to 10 ft. in length and up to 8⅝ in. in dia. under loads encountered in service.

This machine has an overall length of 20 ft., width of 7½ ft., and height of 4 ft. Pipe specimens, mounted as a cantilever beam in the machine, are subjected to bending loads and rotated in a horizontal position by a 20-hp. electric motor at variable

A view of new tube testing machine showing the load housing at left and main spindle housing at right.

speeds up to 1000 rpm. by means of a V-belt and 12-in. drive spindle.

Load is applied by a calibrated spring which is compressed hydraulically by means of a hand pump. The position is locked by two nuts. Bending loads are indicated on a removable dial in units of approximately 6.7 lb., a calibration chart being used to show their exact magnitude.

FELT IS USED IN EVERY CAR ...IN EVERY AUTOMOBILE FACTORY

Lubrication — Sealing — Insulating — Cushioning — Anti-Rattle
Anti-Squeak — Sound Absorption — Polishing — Silencing — Washers
Gaskets — Liners — Channels — Weatherstrip — Packing — Filtration

1 FAN BEARING OILER. 2 WATER PUMP PACKING AND OILER. 3 GENERATOR BEARING SEALS. 4 GENERATOR AND STARTER LUBRICATING WICKS. 5 OIL FILTER 6 BATTERY POSITIVE TERMINAL ANTI-CORROSION WASHER. 7 BRAKE BOLT OILER. 8 STEERING KNUCKLE TO TIE ROD DUST SEAL AND FLANGE JOINT SEAL. 9 STEERING ARM BEARING OILER. 10 FRONT WHEEL BEARING SEAL. 11 WHEEL BRAKE SHOE OILER. 12 CARBURETOR. 13 STEERING COLUMN GROMMET. 14 TRANSMISSION OIL SEAL WASHER. (SEAL ASSEMBLY TRANSMISSION BEARING) 15 DRIVE SHAFT DUST SEAL. 16 TOE BOARD AND FLOOR BOARD LINER. 17 CLUTCH HOUSING PAN DUST SEAL. 18 BODY TO CHASSIS STRIPS. 19 WINDSHIELD WIPER PIVOT ARM MOUNTING. 20 WINDOW LIFT LUBRICATORS. 21 DOOR PANEL INSULATOR. 22 FLOOR BOARD PARTS. 23 UNIVERSAL OIL SEAL. 24 TURRET TOP INSULATION. 25 WINDOW RUN CHANNEL. 26 REAR AXLE DRIVE SHAFT SEAL. 27 AXLE PINION DRIVE BEARING SEAL. 28 UPHOLSTERY RISER STRIPS 29 SPRING COVER LINING. 30 REAR PANEL WEATHERSTRIP. 31 FUEL TANK STRAP GASKET.

Write for S.A.E. Data Sheet No. 5, containing samples and full specifications of the standard S.A.E. Felts.

American Felt Company
TRADE MARK

GENERAL OFFICE: GLENVILLE, CONN.
Engineering and Research Laboratories: Glenville, Conn. PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.
SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal.

Some Additional Applications of Felt: Clutch release link lever oiler • Window anti-squeak • Fuel tank support lining • Brake shoe anchor pin washer • Drag link dust cover • Intermediate steering arm bearing seal • Windshield wiper motor washer • Toe and floor board anti-squeak • Solenoid cover gasket • Heater core to housing filler • Spindle bolt grease retainer • Spindle bolt dust washers • Radius rod felt • Hydraulic lift spring seat • Door bumpers • Pedal pads and seals • Dash liners • Oil retainers • Polishing felts, for glass, metal and paint • Door liners • Ventilator valve seals • Weather seals • Hood lace filler • Moulding shim • Timing gear cover pad • Accelerator rod pad • Fuel tank shim • Propeller shaft spline oiler • Paint filter bags • Crankcase oil filter cap • Brake dirt seals • Defroster control valve seal • Hand brake cable clamp seal • Windshield division filler • Pinion bearing retainer packing • Horn wire locator felt • Oil sabre dust washer • Fender welt felt • Spring oiler felt • Spring bumpers • Gas filling protector pads • Rocker arm seals • Chafing strips for convertible tops • Upholstery padding • Radio selector pads • Thrust bearing inserts • Cab roof lining • Antenna weather seal • Blankets for protection during assembly and service • Factory table pads • Glycerine pads for windshield wipers •

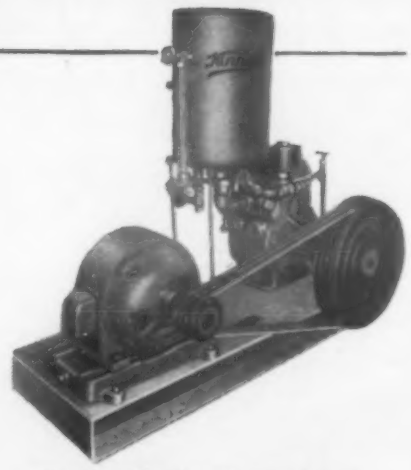
KINNEY VACUUM PUMPS

HELP THE WORLD'S BIGGEST EYE PULL DOWN THE STARS

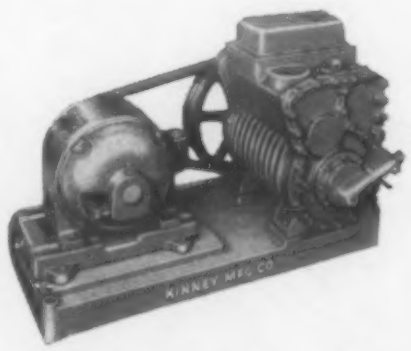
The 200-inch mirror of the giant telescope at Palomar is coated with a micro-thin film of aluminum applied under low absolute pressure produced by Kinney High Vacuum Pumps. This reflective surface of tremendous light-gathering power, vastly superior to ordinary silver coatings, will permit scientists to probe the outermost fringes of the universe.

The everyday work of Kinney High Vacuum Pumps, while less spectacular, is producing many new products of headline importance. Kinney Pumps are "standard practice" in exhausting lamps and tubes, producing drugs, sintering metals, coating lenses, dehydrating foods and performing countless other low pressure operations. These pumps are dependable — and economical — in any range of vacuum, high or low, down to 0.5 micron.

Write for your copy of illustrated Bulletin V-45 describing the full line of Kinney High Vacuum Pumps.



Kinney Single Stage Pumps are available in 8 sizes with displacements from 13 to 702 cu. ft. per min. Will test to low absolute pressures of 10 microns or better.



Kinney Compound Pumps are available in 2 sizes with displacements of 15 and 46 cu. ft. per min. They test to low absolute pressures of 0.5 micron or better.

KINNEY MANUFACTURING COMPANY
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New York • Chicago • Cleveland • Philadelphia • Los Angeles • San Francisco
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GENERAL ENGINEERING CO. (RADCLIFFE) LTD., Station Works, Bury Road, Radcliffe, Lancashire, England
HORROCKS, ROXBURGH PTY., LTD., Melbourne, C.I. Australia
W. S. THOMAS & TAYLOR PTY., LTD., Johannesburg, Union of South Africa
NOVELECTRIC, LTD., Zurich, Switzerland

WE ALSO MANUFACTURE LIQUID PUMPS, CLUTCHES AND BITUMINOUS DISTRIBUTORS

New Materials and Equipment

New Analyzer Checks and Sorts Metal Parts

Nondestructive metallurgical examination and sorting of metal parts can be accomplished with the new portable magnetic analyzing instrument announced by *J. W. Dice & Co.*, 191 River Rd., Grand View-on-Hudson, N. Y.

The instrument operates on the core-loss principle and has a wide range of test fre-

This magnetic analyzing instrument is useful in quality control work.

quencies (2 kc. to 200 kc.). Known as Model C, the device is particularly applicable to the checking or sorting of metal parts on the basis of analysis, structure, hardness, case depth, and in some cases, stress concentration.

In the field of stress measurements, it can be employed to trace internal stress changes, compare stresses at different levels, or measure stress in psi. (by calculation). A recorder output is provided for this use of the instrument.

Abrasive Belt Finishing Machine for Flat Stock

A new abrasive belt finishing machine for flat stock has been announced by *W. J. Holtmeir, Inc.*, 71 W. 23rd St., New York 10. It is capable of finishing stock up to approximately 10 in.

The abrasive belt runs over a rubber contact wheel with an opposing steel billy roll that is adjustable for any thickness up to 1 in. Work can be fed manually, by coil unwinding and winding machines, or by conveyor. Minimum length of stock that can be handled is 9 in.

The abrasive belt drive motor, belt tension and micrometer tracking devices are

PHOSPHOR BRONZE SPRING WIRE

- **Increases Tensile Strength 10,000 Pounds per Square Inch**
- **Gives Greater Stability and Prevents Brittleness**
- **Improves Your Springs at NO extra cost**

HI-10

New advances in spring design—stronger, longer-lasting springs at *no extra cost*—these are the twin advantages of HI-10 Phosphor Bronze Spring Wire.

HI-10

Newest product of Riverside research, HI-10 is warranted to increase tensile strength at least 10,000 pounds per square inch over established standards. It also adds stability and prevents brittleness or any other detrimental effect from aging. Yet, in Grade "A" wire there's no change in standard alloy specifications. HI-10 improves your springs *without* forcing changes in equipment or processing methods—*without* increasing your production costs.

HI-10

The special Riverside processing increases the tensile strength of Grade "E" (3% tin) Phosphor Bronze Wire, so that it now possesses the same tensile values presently covered by standard specifications for Grade "A". This lowers your production costs without affecting the quality of your springs. And at the same time, strategic and allocation-controlled tin is conserved.

HI-10

Grade "E" HI-10 Phosphor Bronze Wire is highly recommended for formed springs *other than* coil springs. These spring forms are often very difficult to manufacture because of severe bending requirements. Grade "E" HI-10 Phosphor Bronze Wire has excellent ductility and permits twisting and bending to degrees beyond those which can be endured by spring temper Grade "A" Phosphor Bronze Wire. Thus, if you have experienced trouble with the manufacture of such items, Grade "E" HI-10 Phosphor Bronze Wire could be the problem-solver.

HI-10

In both Grade "A" and Grade "E", HI-10 Phosphor Bronze Spring Wire is supplied in sizes from .182" diameter down to .0159". Riverside HI-10 is characterized by a somewhat darker, iridescent surface than ordinary phosphor bronze spring wire processed in the conventional way.

We shall be glad to furnish trial orders at published base prices, with prevailing extras for quantity and size differentials. For full details of HI-10 write today.

RIVERSIDE MAKES A FULL RANGE OF STANDARD (AND SOME SPECIAL) NICKEL SILVER AND PHOSPHOR BRONZE ALLOYS

THE RIVERSIDE METAL COMPANY

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NEW YORK, CHICAGO, HARTFORD, CLEVELAND
R. J. LEAHY & COMPANY
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RIVERSIDE

PHOSPHOR BRONZE
NICKEL SILVER
BERYLLIUM COPPER
CUPRO NICKEL

EF

GAS-FIRED
OIL-FIRED
and ELECTRIC
FURNACES
for

- AGING
- ANNEALING
- BRAZING
- CARBON RESTORATION
- CARBURIZING
- CERAMIC DECORATING
- DRAWING
- HARDENING
- HOMOGENIZING
- MALLEABLIZING
- NORMALIZING
- NITRIDING
- SINTERING
- SOLUTION TREATING
- SPECIAL ATMOSPHERE TREATMENTS

A SIZE AND TYPE OF FURNACE FOR EVERY PROCESS PRODUCT OR PRODUCTION

SCALE FREE FINISH ANNEALING
5000 lbs. of brass strip per hour

● The gas-fired roller hearth furnace pictured above is of EF's semi-continuous intermittent operating design, with separate chambers for preheat, anneal and cool. Special ratio controls produce the exact atmosphere desired, and an ingeniously designed forced circulation system assures a uniform anneal and surface finish day after day. Let us show you how EF research, EF design, and EF experience has greatly advanced the metallurgical processing of ferrous and non-ferrous metals, resulting in closer physical tolerances, uniform finish, and efficient, low cost, trouble-free operation

THE ELECTRIC FURNACE CO.
WILSON ST. AT PENNA. R.R. Salem-Ohio

EBONOL
blackening processes

EBONOL-C. (U. S. Patent 2,364,993) This is the best method of blackening and coloring copper and its alloys. Durable black cupric oxide is produced in a simple solution. Any metal that can be copper plated can also take this finish.

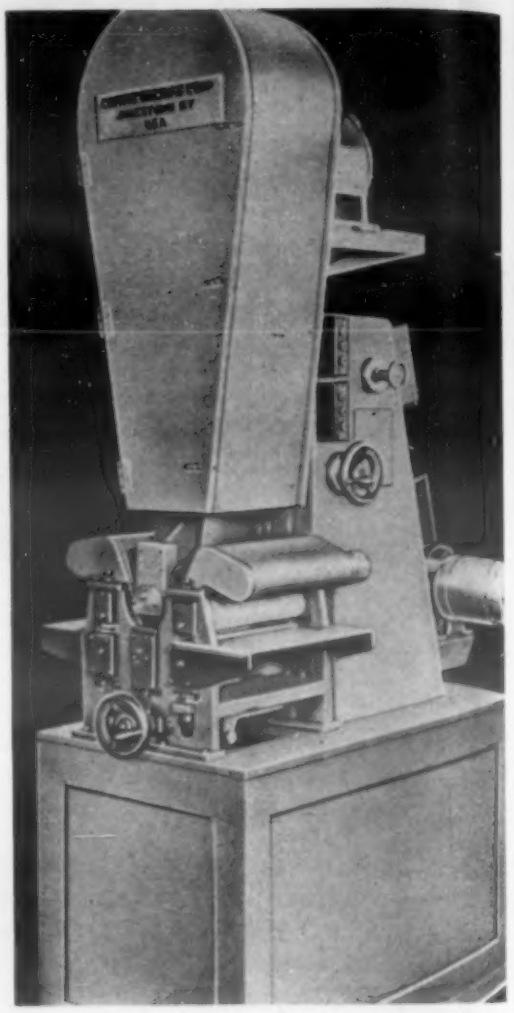
EBONOL-S. A one-bath method of blackening steel. Temperature 285 to 290° F. Simple to use and pleasant to run.

EBONOL-Z. A simple process for blackening zinc plate and zinc base diecastings. Beautiful glossy or dull finishes are achieved at low cost and trouble-free operation.

NEW TUMBLING TECHNIQUES are available for blackening and coloring. Send samples for free finishing demonstrations together with advice of experienced research chemists. Write for new literature with procedures.

ENTHONE INC. • 442 Elm Street, New Haven, Conn.

New Materials and Equipment



Belts on this abrasive finishing machine can be easily changed for coarse, medium and fine polishing.

arranged for easy alignment and belt changing. Accurate setting of the billy roll is assured by twin screws and precision slides. The billy roll may also be offset slightly, parallel to the contact roll if desired. The size of the machine is: width, 24 in.; depth, 42 in.; height, 91¾ in.; work height, 38 in.

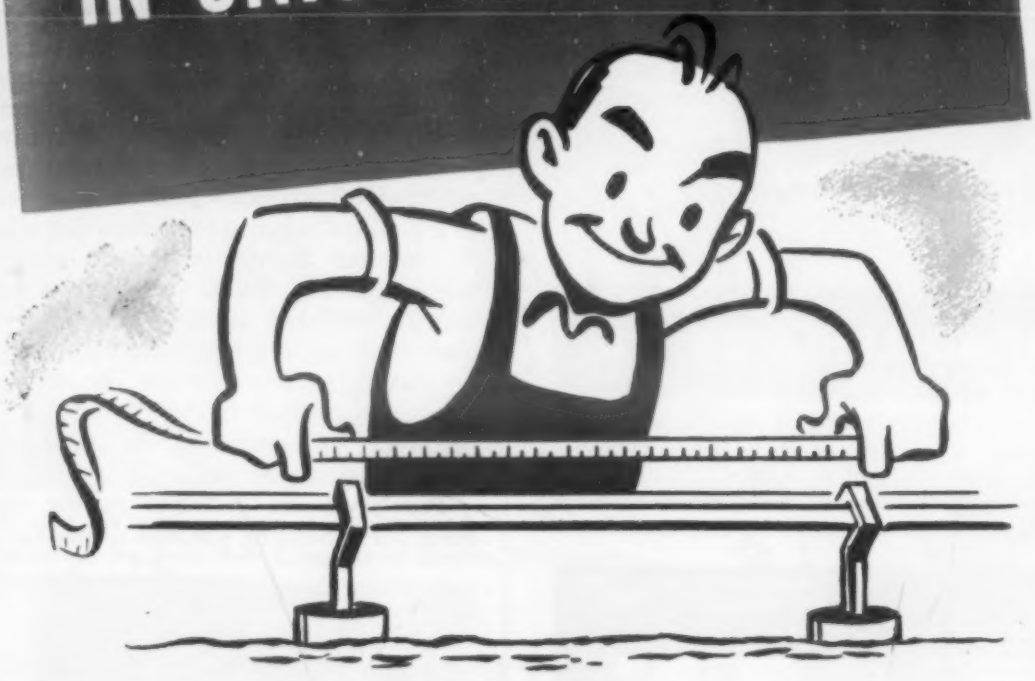
Electrical Insulators Improved by Use of New Material

Ceramic insulators for higher frequencies in communications and electronic equipment requiring a material with an improved loss factor are now available from the *American Lava Corp.*, Chattanooga 5, Tenn. The new material, known as ALSiMag 228 (Glazed), is being used for many bushings, lead-in insulators, flanged lead-in insulators, a variety of cylindrical, conical and square standoff insulators, line spreaders, strain insulators, and couplings.

The significant electrical characteristics of the material are: dielectric constant (1 mc.), 6.3; power factor (1 mc.), 0.0012; and loss factor (1 mc.), 0.0076.

YOU TIE UP FEWER ANODES IN UNICHROME COPPER

. . . and make sure of 100% anode-efficiency, besides!



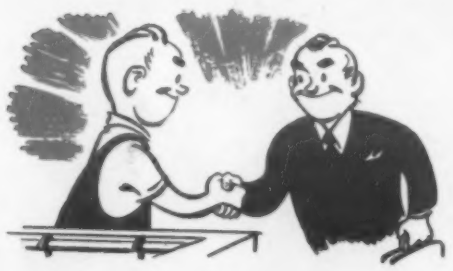
IT'S MONEY IN YOUR POCKET instead of copper in your tank when you plate with *Unichrome* Copper. For anodes always corrode evenly—even at high current densities. So you get 100% anode-efficiency—*with 50% to 75% fewer anodes!* And that adds up to plenty of poundage in most installations.

And this is only one of five important advantages you get from the mildly alkaline, all-purpose Unichrome process. Which is why we say: Compare it with any other process, and we believe you'll specify Unichrome Copper every time! *Write for helpful technical bulletin.*

BUFFING TIME IS CUT—often eliminated entirely—because Unichrome Copper gives you a *smoother* deposit. And because it's a *fast* process, you save time in the tank as well. Only when you save *both* ways do you really lower plating costs.

NO CYANIDE is used in the Unichrome Copper bath—so you not only reduce your stocks of this hazardous chemical, but get a safer bath as well.

CLEAN DEPOSITS never need activation. With no brighteners, no wetting agents used, Unichrome deposits come out clean, ready for the nickel cycle without special treatment.



HELPFUL SERVICE—Unichrome Copper is simple to maintain, seldom gives trouble. But should the need arise, you can always count on prompt help from our engineers and analytical laboratories.

UNICHROME

PROCESSES AND MATERIALS FOR SURFACES THAT SURVIVE

Chromium Plating • Porous Chromium • Unichrome* Copper
Unichrome Lacquers • Ucilon* Protective Coatings
Unichrome Stop-Off Lacquers and Compounds • Unichrome Dips
Unichrome Rack Coatings • Anozinc* Compounds • Unichrome Strip

*Trade Mark Reg. U. S. Pat. Off.

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AJAX

HIGH TENSILE MANGANESE BRONZE

- *high in strength, toughness and corrosion resistance . . . . . .*
- *long time favorite with manufacturers of marine fittings . . . . . .*
- *leaves sand clean and bright—takes a mirror-like finish . . . . . .*
- *recognized as the highest quality manganese bronze available . . . . . .*

AJAX METAL CO. PHILADELPHIA 23, PA.

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AJAX ELECTRIC • AJAX ELECTROTHERMIC CORP. • AJAX ELECTRIC FURNACE
AJAX ENGINEERING CO

With an unfailing supply of premium steel, JOHNSON nationwide, streamlined service on high-quality specialty steel wires is in high gear . . . . and with it JOHNSON unexcelled quality. Laboratory supervision from mine to finished product.

There is a Johnson office near you, and warehouse stocks in Worcester, Chicago and Los Angeles.

JOHNSON

STEEL AND WIRE COMPANY, INC.

WORCESTER 1, MASS.

New York Philadelphia Cleveland Detroit Akron Chicago
Atlanta Houston Tulsa Los Angeles Toronto

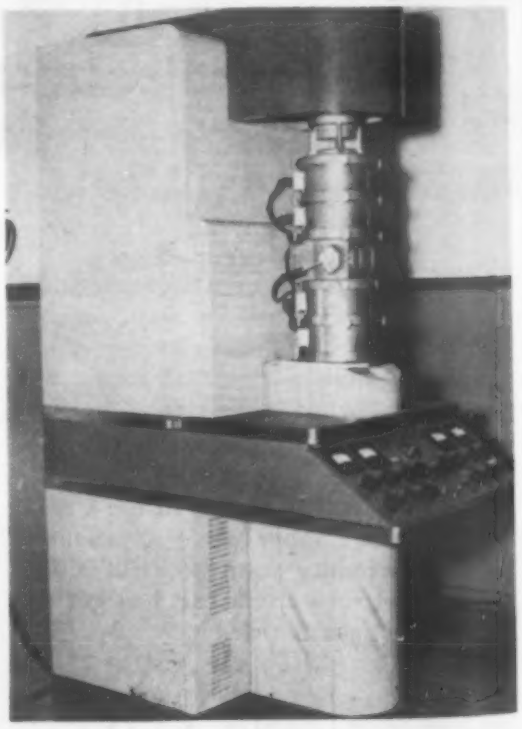
New Materials and Equipment

Electron Diffraction Unit Has Industrial Applications

An electron diffraction unit for industrial and research applications has been developed by the *Radio Corp of America*, Camden, N. J. It will aid in observing and measuring conditions on surfaces or in thin layers of materials such as metals, ceramics and plastics.

The new instrument, which will permit chemical analysis of substances weighing as little as 1/28 millionth of an ounce, is said to provide the best known methods of studying the "submicroscopic" surfaces of metals to uncover the action of corrosion and rust contamination. It reveals the chemical composition and atomic arrangement of crystalline substances by directing a beam of electrons through a minute specimen, thus producing diffraction patterns which may be observed visually on a fluorescent plate or from a photographic print. Since no two substances produce the same pattern, it is possible to identify an unknown substance by comparing its pattern with known patterns on file.

Provisions are included in the instrument for producing electron diffraction patterns by either the reflection or the transmission method. The instrument will also produce shadow micrographs, an essential feature for examining the area of the specimen from which diffraction patterns are obtained.



This electron diffraction unit can be used for investigations of corrosion, surface deposits, and many phases of metallurgy.

The new instrument, which resembles RCA's universal model electron microscope in size and shape, consists of an optical system, power supplies, a vacuum system, and a control panel.

One man does the work of three—fastening heads on oil heaters manufactured by the Easy Heet Company of Seattle, Washington.

The gun pulls the rivet stem. Expands the rivet shank. Forms a head on the blind side

CHERRY BLIND RIVETS

MAKE THE HARD JOBS EASY

"WE ARE SAVING APPROXIMATELY 30 PER-CENT by using Cherry Rivets in place of sheet metal screws." Simple, quick assembly-line fastening with Cherry Rivets resulted in substantial labor-cost savings for this manufacturer. Highly adaptable to production-type assembly work, Cherry Rivets conform to curves, bends, and tight angles as well as to a wide range of materials. Cherry Rivets are used in Marine, Metal Signs, Railroad Shops, Aviation Plants, etc.

COMPARABLE TO SOLID RIVETS Cherry Rivets have shear values comparable to solid rivets . . . They're much easier to use in a wide range of applications . . . Only one man is needed . . . There's no "bucking" with Cherry Rivets.

VIBRATION-RESISTANT Cherry Blind Rivets have excellent hole-filling qualities and high clinching action between the shank of the rivet and the materials fastened. They hold *tight* where screws or bolts may work loose under vibration.

TAMPER-PROOF The tamper-proof qualities of Cherry Rivets add to their proved dependability. With the proper tools, however, a service representative can easily remove and replace Cherry Rivets without any change in the excellent appearance of your product.

Cherry Rivets are made from aluminum alloy, steel, or Monel. Standard rivets come in five diameters and two head styles. There is a wide range of grip lengths. Special heads, diameters, grip lengths, and alloys can be made to order. Write today for further information. Address **Department A-251, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.**

CHERRY RIVETS. THEIR MANUFACTURE & APPLICATION ARE COVERED BY U. S. PATENTS ISSUED & PENDING

Cherry Rivet Company

LOS ANGELES 13, CALIFORNIA

CHERRY RIVETS ARE APPROVED BY CIVIL AERONAUTICS AUTHORITY AND UNDERWRITERS' LABORATORIES, INC.

It's Here!

The BARON formerly FINELT

WAX INJECTOR

. . . acclaimed as the finest machine of its kind. A versatile, precision-made unit, ideally adapted to wax injection into both rubber *and* metal molds . . . can be used as either a hydraulic or air-pressure operated unit.

The BARON Injector

Check these features against any other wax injector on the market:

- **Hydraulic or air-pressure operation**
- **Positive temperature control to within two degrees**
- **Positive pressure control to a fraction of a pound**
- **Complete control over the quantity of wax injected**
- **Complete visibility of temperature and pressure at all times**
- **Full two-quart capacity**
- **Designed for rapid wax pattern production**
- **Designed for simple fool-proof operation**
- **Available for operation on any type of electric current**

Dealers and Jobbers Inquiries Invited

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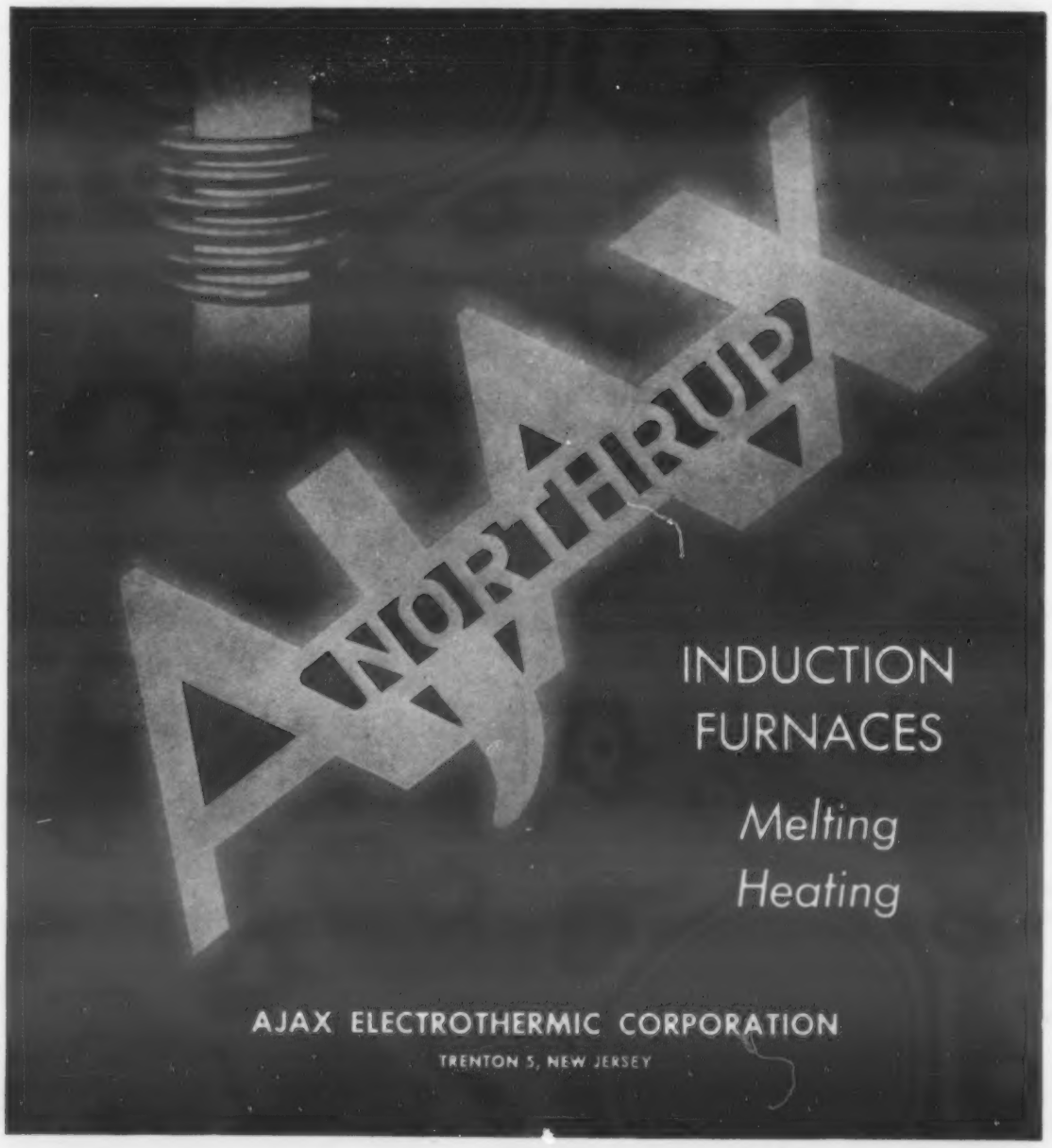
precision casting sales and engineering



News of...

ENGINEERS COMPANIES SOCIETIES

Engineers

The Oliver Iron & Steel Corp. has announced the appointment of *Allyn E. Harper* as chief plant engineer. Mr. Harper previously was plant engineer of the General Cable Corp. Another appointment was that of *William N. Boyd* as superintendent of the Industrial Fasteners Manufacturing Div. of Oliver.

Several new members have been added to the staff of Battelle Memorial Institute, including *Bernard A. Gruber,* formerly a chemical engineer at the Harshaw Chemical Co., who will now conduct research in nonferrous metallurgy; Dr. *H. P. Munger,* for 19 years associated with the steel industry in product development and production work, will be engaged in research in chemical engineering; and *Robert Mabie Parke,* an authority on the production and development of refractory metals, will act as technical advisor in Battelle research on high-temperature-resistant materials.

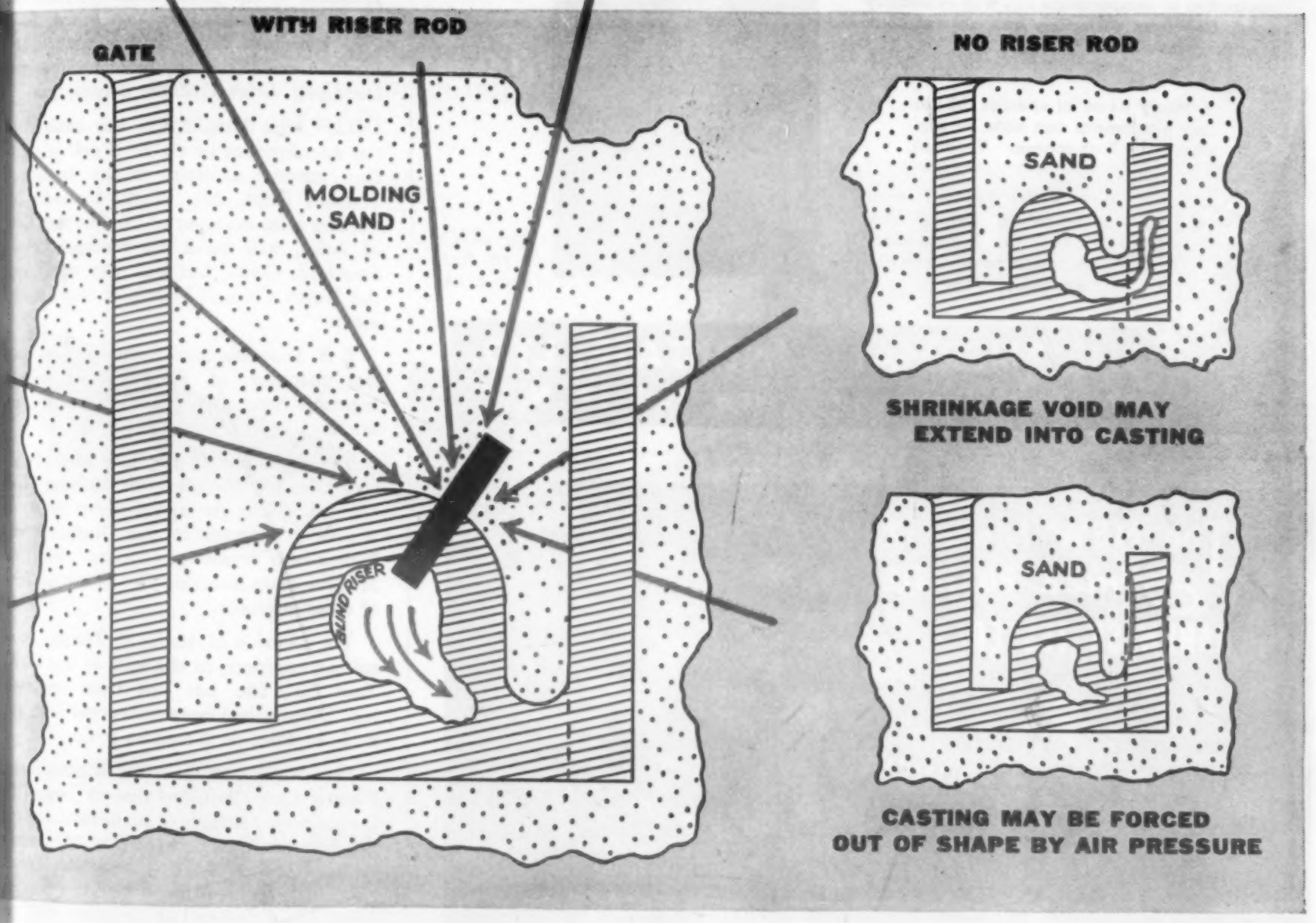
N. George Belury has been appointed president of the Engineered Castings Div. of the American Brake Shoe Co. Mr. Belury, formerly division vice president, will continue to be located at the Division's headquarters in Rochester, N. Y.

The new director of research, development and production of the Metric Lacquer Manufacturing Co. is Dr. *Marcus Thau,* who has had 25 years of experience in the field of protective and decorative coatings. Dr. Thau was previously associated in a similar capacity with the Lacquer & Chemical Corp.

Several appointments at the General Electric Co. resulted in Dr. *James R. Donnalley* becoming manager of G.E.'s silicone manufacturing plant at Waterford, N. Y. *W. W. Kuyper* is now divisions engineer of the Turbine, Generator & Gear Engineering Divs. of G.E.'s River Works, Lynn, Mass. He succeeds *K. M. Holt,* who is retiring after more than 40 years of service to the company. *L. J. Collins* has succeeded *E. N. Twogood* as division engineer of the Gear Engineering Div. Mr. Twogood was associated with G.E. for more than 38 years upon his retirement. *J. J. Zrodowski* has become

Air pressure feeds your casting with sound metal!

(WHEN YOU USE "NATIONAL" GRAPHITE RISER RODS)



●By inserting a "National" graphite riser rod into the mold—as shown above—you keep the blind riser open to the atmosphere during solidification of the metal. The red arrows show how air pressure pushes powerfully through this hole. It forces molten metal into the casting with considerable force.

The result: Air pressure works *for* you—not *against* you. Air pressure does not warp the casting out of shape, as it might if there were no riser rod to relieve the internal shrinkage. Air pressure packs metal where a vacuum tries to exist, and the shrinkage void is left in the riser...not in the casting. The result is a sound, true-to-shape casting.

You can buy "National" graphite riser rods in standard sizes... from the smallest to the largest. They reach you in a handy package, all ready to place in the mold. "National" graphite riser rods save time because they are so easy to use. They do a better job than other rods because they keep riser metal fluid longer—force-feed more metal into the casting.

The term "National" is a registered trade-mark of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

FOR MORE INFORMATION ON "NATIONAL" GRAPHITE RISER RODS, WRITE TO NATIONAL CARBON COMPANY, INC., DEPT. MM

VITREOSIL (Vitreous Silica)

TRANSPARENT

(Vitreous Silica or Quartz Glass)

• **Because of its extraordinary transparency to ultra-violet and infra-red rays, Vitreosil apparatus is particularly suitable for metallurgical investigations, physical, optical and electrical research where temperature conditions render the use of glass inadvisable. Transparent Vitreosil is unaffected by thermal shock, halogen gases and acids (except hydrofluoric and phosphoric) at any concentration or temperature . . . it is extremely hard, free from distortion and an excellent electrical insulator.**

• **Many items of special laboratory equipment can now be supplied in Transparent Vitreosil.**

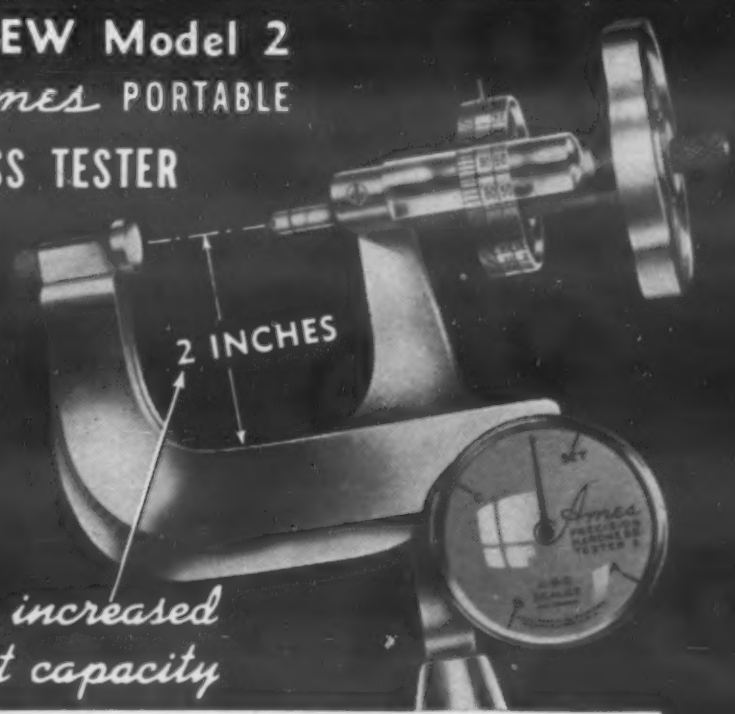
• *Write for bulletins describing the applications of Transparent Vitreosil to research and analytical work.*

VITREOUS SILICA — VITREOSIL — REG'D TRADE MARK

THE THERMAL SYNDICATE, LTD.

12 East 46th St. • New York 17, N. Y.

The NEW Model 2 *Ames* PORTABLE HARDNESS TESTER



WITH *increased throat capacity*

Now a new Ames Portable Hardness Tester with 2" throat capacity (depth and width) for greater range. Tests flat and round stock, tubing and odd-shaped pieces directly in the Rockwell Scales. Anyone can operate to obtain accurate readings. Used by technicians, engineers, inspectors, stockmen and salesmen.
Ames Testers are available in other sizes.
Write for new bulletin.

AMES PRECISION MACHINE WORKS

WALTHAM 54, MASS., U. S. A.

News of...

ENGINEERS COMPANIES SOCIETIES

designing engineer of the Gear Engineering Div.

George W. Coultas has joined the industrial engineering staff of the Parker Appliance Co. He was formerly associated with the Reliance Electric & Engineering Co. and the Eaton Manufacturing Co. in industrial engineering capacities.

The election of *Howard M. Dawson* as president of the Jessop Steel International Corp., a subsidiary of the Jessop Steel Co., has just been made public. Mr. Dawson was previously vice president and managing director of the corporation.

The Atlas Powder Co. has announced the appointment of *G. B. Work* as assistant general manager of its Industrial Finishes Dept. Mr. Work, formerly industrial sales manager of the Finishes Div. of Atlas, will make his headquarters at Stamford, Conn., but will also work with the North Chicago branch of the Department.

J. B. Scott has been named quality control manager of Borg-Warner Corp.'s Ingersoll Steel Div. plant at Kalamazoo, Mich.

The expansion of the Sheet Metal Products Div. of Designers for Industry, Inc. has resulted in the appointment of *B. A. Woina* as director of the Division. Mr. Woina was formerly associated with the Mullins Manufacturing Co. in the capacity of chief engineer.

The addition of *Martin C. Duttors*, consulting engineer, to the staff of the O. K. Tool Co., Inc. has just been reported. Mr. Duttors had been connected with the E. I. du Pont de Nemours & Co., Inc.

Several promotions at the Westinghouse Electric Corp. included that of *James W. Fatkin*, now manager of manufacturing for the Aviation Gas Turbine Div. Mr. Fatkin replaces *Samuel S. Stine*, who was named plant manager of the company's Kansas City works, where jet engines will be built for the Navy. *Peter A. Roos* succeeds Mr. Fatkin as superintendent of blade and diaphragm manufacturing at the Philadelphia plant. And *Dewey H. Martz* has been named superintendent of assembly and test, also at Philadelphia.

The Glidden Co. has announced the promotion of *James C. Rankin* to the post of executive assistant. Mr. Rankin previously was manager of specialty sales of Glidden.

E. V. Crane has joined the staff of the Hydraulic Press Manufacturing Co. as its chief engineer. Mr. Crane, a well-known authority on the subject of metal working, had previously been connected with the E. W. Bliss Co. and Sam Tour & Co., Inc.

(Continued on page 140)

If You Use SHEET STEEL...

Let International quote on decoiling, flattening, cutting, and pickling. Also on coil-slitting. International's mill-type equipment handles these services at low cost, and assures dependable supplies even though mill facilities are crowded.

Hundreds of manufacturers look to International for steel service to assure a steady flow of incoming materials. Perhaps similar service can be arranged for you . . . it will pay to inquire.

Coils up to 9 gauge (.150) can be handled by International's Flying Shear

Sheets from the Flying Shear are smooth, uniform, accurate to size

One of International's three coil-slitters that handle coils up to 60 inches wide

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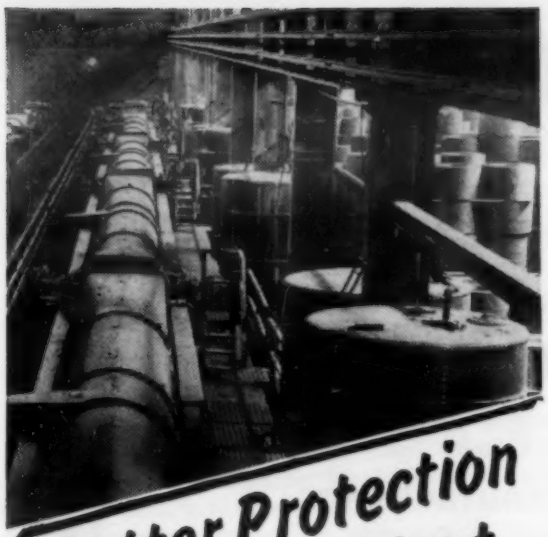

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24, 35 & 40

In your plant the walls, floors, piping and structural members — tanks and other equipment — may be exposed to a continuing process of corrosion. Safeguard your plant investment — as many others are doing so successfully — with NUKEMITE.

NUKEMITE 24
A decorative coating for use where corrosive fumes or drippage prevail and ordinary oil-based coatings have proven unsatisfactory. No primer or basecoat needed. Easily applied by brush or spray method — no "curling" or "lifting" of paint surface beneath.

NUKEMITE 35
A heavy-viscosity solution which upon drying forms a dense, tough tank lining of unusual elasticity. Easily applied as a liquid coating with strong adhesive quality.

NUKEMITE 40
Protective coating for applications similar to those of *Nukemite* 24, but against conditions requiring greater corrosion and abrasive resistance. Specially recommended as a concrete-floor finish.

Write for the Nukemite Bulletin you need— today!

Nukem

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PRODUCTS CORPORATION
97 Colgate Avenue
BUFFALO 20, N. Y.

News of...

ENGINEERS COMPANIES SOCIETIES

The election of *Robert K. Follansbee* as vice president in charge of sales of the Follansbee Steel Corp. occurred recently. *C. F. K. Appel* succeeds Mr. Follansbee as acting secretary and treasurer. The company also announced the appointment of *George W. Ballantine* as sales manager of its Sheet Metal Specialty Div. Mr. Ballantine formerly was associated with the Republic Steel Corp.

The Reliance Electric & Engineering Co. has named *William J. Hall* production manager of its Ivanhoe Div. Mr. Hall previously was night superintendent of the Division.

The appointment of *Charles L. Neely* as sales manager of glues and industrial resins for the Plaskon Div. of the Libbey-Owens-Ford Glass Co. has just been revealed. Before going to the Toledo offices, Mr. Neely represented Plaskon in the Southeastern area.

A new roster of officers of the Superweld Corp. consists of *Lee Cameron*, president and general manager, who succeeded *Walter T. Wells*, now chairman of the board. *S. S. Webster, Jr.* has been named secretary, and *Robert E. Jones*, vice president, was elected treasurer.

Lemuel B. Hunter has accepted the position of manager of the Raw Materials Dept. of the Inland Steel Co. *Carl B. Jacobs* succeeds Mr. Hunter as fleet manager of the company.

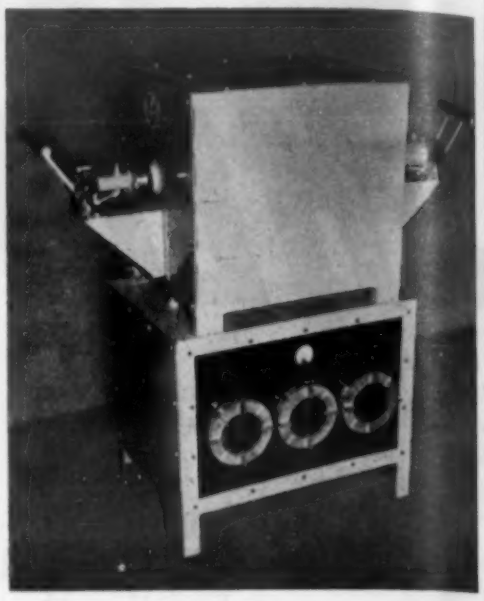
The American Society for Metals has announced that *Taylor Lyman* will become an associate editor of *Metal Progress* on January first. Mr. Lyman is also editor of the "Metals Handbook", another publication of the Society.

Lafayette College has appointed *James C. Wilson* an instructor in its Department of Mining & Metallurgical Engineering. Mr. Wilson previously was associated with the Lunkenheimer Co. and the Hamilton Foundry & Machine Co.

Thomas J. Lingle has joined the Taylor Forge & Pipe Works as Western division manager in charge of manufacturing operations at Taylor's new plant in Fontana, Calif. Mr. Lingle, who formerly operated his own valve and fittings business in Alhambra, Calif., will also direct West Coast sales of the company.

The Lewis Foundry & Machine Div. of the Blaw-Knox Co. announces that *John P. Wilkinson* has joined its staff in the capacity of assistant to the president. Another appointment resulted in the promotion of *James M. Lewis* to manager of roll sales for the division.

Announcement has been made by Oakite Products, Inc. of the appointment



HARPER TUBE FURNACE Model GT-20 HM-30

Harper

HIGH TEMPERATURE

Electric

TUBE FURNACES

for General Research

Temperatures To 3000°F

Research laboratories have a need for a small high temperature atmosphere test furnace for research on new products and new methods. The above furnace provides economical equipment for the intermittent testing of small samples. Materials can be heated to maximum temperatures and cooled quickly, enabling tests to be made during a working day with a saving in laboratory time. Power requirements are low and when working with special atmospheres gas lines can be turned off when firing is completed.

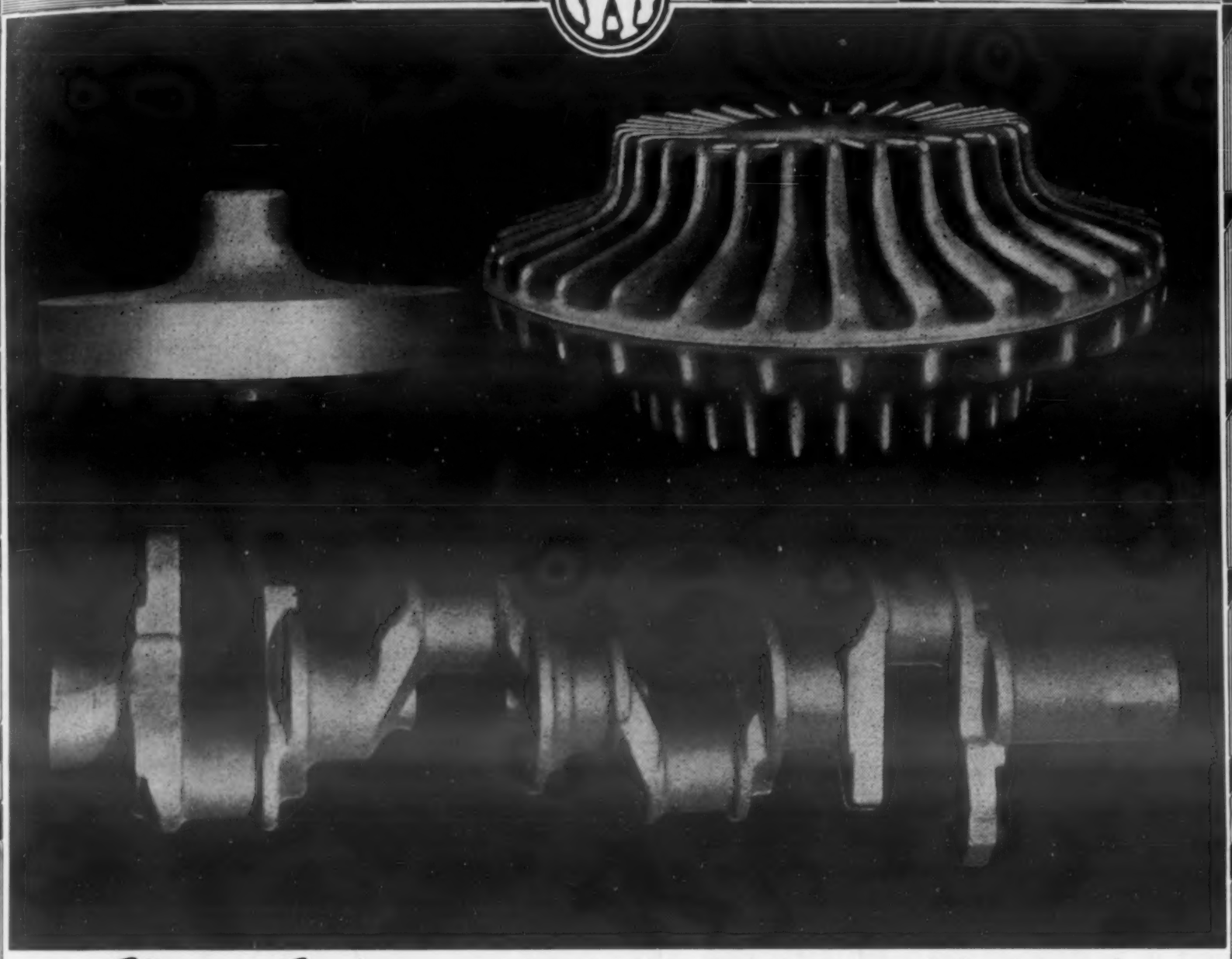
Uses of this furnace include: Sintering, Brazing, Heat Treating, Bright Annealing, Testing in Special Atmospheres, and General Research.

The above furnace is available in several sizes. Harper Engineers will be glad to work out special features to meet individual heat treating needs.

Write for Bulletin No. 1148.

HARPER ELECTRIC FURNACE CORPORATION
1461 Buffalo Avenue
Niagara Falls, N. Y.

Representatives in principal cities.



Wyman-Gordon—specialists in the vital forgings of the internal combustion engine since its inception—is today the largest producer of crankshafts for the automotive industry and of all types of forgings for the aircraft industry.

Be it crankshafts and other vital forgings for the piston type engines or turbine wheels and impellers for turbo jets—there is no substitute for Wyman-Gordon experience.

Standard of the Industry for More Than Sixty Years

WYMAN-GORDON

Forgings of Aluminum, Magnesium, Steel

WORCESTER, MASSACHUSETTS, U. S. A.

HARVEY, ILLINOIS - - - DETROIT, MICHIGAN

a big saving

was made in the production of this small part by **precision investment casting**

This is a new manganese bronze part used in television cameras.

The precision investment method of casting was adopted because of the tremendous saving offered by this process and the fine finish obtainable . . . There was, in this case, a lower mold and fixture expense and substantial piece price savings.

The part, as illustrated, required one reaming, one tapping and three drilling operations to complete for assembly.

Permit us to show you how your product can be produced better and more economically by precision investment casting.

Please use coupon.

GRAY-SYRACUSE Inc. . . . . .

107 N. Franklin St., Syracuse 4, N. Y.

Small precision castings of ferrous and non-ferrous alloys.

Gray-Syracuse, Inc.
107 N. Franklin Street
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Please send me literature on Precision Investment Castings
NAME .....
COMPANY .....
ADDRESS .....
CITY .....ZONE.....STATE.....

News of...

ENGINEERS COMPANIES SOCIETIES

of *Frank L. Oldroyd* as sales manager of its Industrial Div. Mr. Oldroyd will direct his industrial field staff from the company's offices in New York City.

Carl L. Radway has been named division superintendent of the cold rolling mills at the Cuyahoga Works of the American Steel & Wire Co., a U. S. Steel Co. subsidiary. Mr. Radway was given this appointment upon the death of *C. M. Sackerson.*

Companies

A $3,000,000 motor manufacturing plant, which at peak production will be able to turn out more than 1500 electric motors weekly, was officially opened by the *General Electric Co.* at San Jose, Calif., recently. This plant will ultimately produce all of the company's output of single-phase capacitor integral motors.

The *Trent Tube Manufacturing Co.* has changed its name to the *Trent Tube Co.* Located at East Troy, Wis., Trent is a subsidiary of the Crucible Steel Co. of America.

Production of Revere Ware has just begun at the new Riverside, Calif. plant of *Revere Copper & Brass, Inc.* All orders and sales correspondence should continue to be sent to the Rome, N. Y. office, however.

The facilities of the *Adamas Carbide Corp.* have been greatly increased in its new plant at 1000 So. Fourth St., Harrison, N. J. Formerly located in Long Island City, N. Y., Adamas has also moved its business office from New York City to Harrison.

A new sales and development organization, the *J. W. Dice & Co.,* has recently been formed by James W. Dice, who previously had been associated with Sperry Products as assistant sales manager. Located at 191 River Rd., Grand View-on-Hudson, N. Y., the new company will specialize in the marketing of industrial and laboratory nondestructive test instruments employing magnetic, electronic, ultrasonic and radiation principles.

Capacity for producing "cold rubber" at the American rubber plant, operated for the government at Port Neches, Tex., by the *B. F. Goodrich Chemical Co.,* will be increased to 30,000 tons annually when

Good NEWS about Burnishing

FROM North, East, West and South comes NEWS that hundreds of metal processors have found Oakite Composition No. 3 to be ideal for burnishing steel, brass, aluminum (wrought or die cast), zinc die castings and silver.

Oakite Composition No. 3 gives rich suds in hard or soft water, lubricates smoothly to prevent metal-on-metal scratching, rinses freely leaving no soapy film on work or balls, improves luster quickly at low cost per unit.

FREE!

Write today for Special Report 6705 giving complete details on Oakite Composition No. 3. Full of information about cleaning and bright-dipping metals before burnishing and best methods of keeping balls and barrels in good condition.

Also, without obligation, ask about Oakite methods for:

- Precleaning in tanks
- Precleaning in machines
- Alkaline cleaning in tanks
- Alkaline cleaning in machines
- Pickling
- Electrocleaning
- Pre-paint treatment in tanks
- Pre-paint treatment in machines
- Steam-gun cleaning
- Paint stripping
- Rust prevention

OAKITE PRODUCTS, INC.
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Technical Service Representatives Located in Principal Cities of United States and Canada

OAKITE

Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

"BE KIND TO INGOTS" DAY

Comes Every Day in C.F.&I's New Pits

Micromax Control on Salem Pits Helps Accurate, Economical Heating

It's the ingot that matters in soaking pit operation! Salem Engineering Co. is thinking about ingot quality when they design and install a 24-pit battery like this, and recommend controls to regulate operation. Colorado Fuel & Iron Corp. is planning the future of ingots and ingot products when they decide on temperature cycles and set up operating procedures.

These planners have assigned Micromax Controllers to help protect the "interests" of the ingots during the long soaking period. Micromax gives this protection from several angles. Of course, it doles out fuel, in exactly varied amounts to heat the great chunks of steel accurately and uniformly. It preserves correct temperatures, despite the effects of charging, pulling and changes in ambient conditions. But Micromax is also tied into the regulation of combustion and furnace pressure, so that these conditions are held firmly in line during the necessary adjustments of heating rate and soak temperature. Result—every day is "Be Kind to Ingots" Day in the pits, and the rolling mill is sure of a constant supply of ingots properly conditioned for processing.

Leeds & Northrup Co., 4925 Stenton Ave., Philadelphia 44, Pa.

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LEEDS & NORTHRUP CO.

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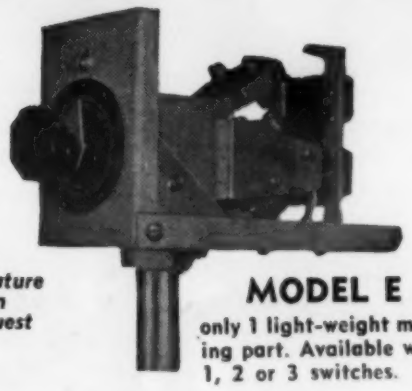
BURLING

TEMPERATURE LIMIT SWITCHES

USE NO LIQUIDS . . . NO GASES



Literature on Request

MODEL E

only 1 light-weight moving part. Available with 1, 2 or 3 switches.

As a 3 switch model, Burling Model E is recommended for use (a) where load is divided into 3 parts, (b) where 1 switch is used for controlling, one as a high limit, one as a low limit, (c) to give definite stops or position to a 3 or 4 position diaphragm motor, (d) to give 3 speed control of variable speed motor.

- Accurate, Rugged, Dependable
- Corrosion and heat resisting tube
- Dial Pointer for easy setting
- Locking screw locks temperature setting
- Terminal plate has large screw terminals
- Snap-action Micro-Switch eliminates contact troubles
- Increased Adjustable range to 700-1000°
- Dimensions—7¼" x 2¾" x 3½"

MODEL V-I

For lower temperature range from 0-300°F. Available for minimum of —100° to maximum of 600°F. Usual adjustable range 50-150°, operating differential may be as small as ±¼ or as large as ±5°. Adjustable by screw and dial inside case. (Sizes 2¾" diameter × 4¼" high.)

MODEL D

Adjustable range 200-500°F. Temperature range 0-1400°F. For use where temperature must be changed to suit operating conditions. Turn outside knob to change temperature setting. (Sizes 5½ x 2¾ x 2¾".)

Instruments also Built to Specifications

Making Precision Controls for Over 12 Years

BURLING INSTRUMENT CO.

Springfield Ave. at Livingston St.

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News of...

ENGINEERS COMPANIES SOCIETIES

installation of equipment needed to make this new type rubber is completed, some time in 1949.

The *Pemco Corp.* has announced the completion of a new Research & Development Laboratory, located at 2552 Greenmount Ave., Baltimore, Md. Concurrently with the opening of this new plant, Pemco also revealed that the Customer Service & Quality Control Laboratories at 5601 Eastern Ave., Baltimore, have been expanded and revised so that all operations are concentrated in a single area.

The change of its corporate name from *Columbia Radiator Co.* to that of the *Columbia Foundry Co.* coincides with the announcement that the company is withdrawing entirely from the heating boiler and radiator business to devote its entire facilities to the manufacture of production gray iron castings. The plant, located at McKeesport, Pa., is being completely modernized, and August Rossetti has been appointed plant manager.

Construction of the only privately-owned tin smelting plant in the United States for the *Vulcan Detinning Co.* has been started at Sewaren, N. J. by the *Wigton-Abbott Corp.* The smelter will utilize a newly-developed process for extraction of the metal from low-grade Bolivan concentrates, expecting to produce an initial volume of five tons of refined tin daily.

The *Carpenter Steel Co.*, Reading, Pa., has dedicated its new research laboratory to those employees who served in the armed forces during World War II. The laboratory was built to further accelerate the company's development of specialty steels for industry.

The former Remington Rand plant in Johnson City, N. Y. has been leased to the *General Electric Co.* by the War Assets Administration for the manufacture of special equipment for the Air Force. The plant, which will be a part of the G.E. Apparatus Dept., will begin production within six to nine months. Walter B. Booth, formerly division superintendent of G.E.'s Carbon Products Div., has been named plant manager.

The formal opening of its new electrochemical laboratory at Matawan, N. J., was celebrated by the *Hanson-Van Winkle-Munning Co.* recently. The laboratory was specifically designed and erected for the sole purpose of carrying on experimental and service work in the electroplating and polishing field.

Plasticizers for vinyl and other synthetic resins will be manufactured by the *B. F.*

Where

CUTTING FLUID

SELDOM does the most carefully developed scientific theory provide the final answer in the shop; neither is practical experience entirely dependable. It usually takes a combination of both in order to select and apply the cutting fluid that will give the best results on a given machining job.

D. A. Stuart Oil Company offers you a combination of theory and practical experience that pays dividends in better machining and fewer production headaches. The *theory* emanates from research in the modern D. A. Stuart laboratories; *practical* approach comes from men who have years of experience in shop problems and techniques. That is why Stuart products so often smooth out jobs on which other cutting fluids fail. Ask your D. A. Stuart Oil Co. representative to tackle your tough jobs.

ON-THE-JOB REPORTS PROVE RESULTS

". . . D. A. Stuart's SOLVOL Water Mixed Cutting Compound was put in on a trial basis for milling high carbon alloy steel. High speed alloy cutters were used and it was found that SOLVOL increased the cutter life 3 to 4 times over what they had been getting. . . ." Write, if you would like to have a booklet on SOLVOL.

STUART oil engineering goes with every barrel

D. A. Stuart Oil CO.

2745 S. TROY ST. • CHICAGO 23, ILLINOIS

The New General Plate Laminated Silver on Aluminum Button

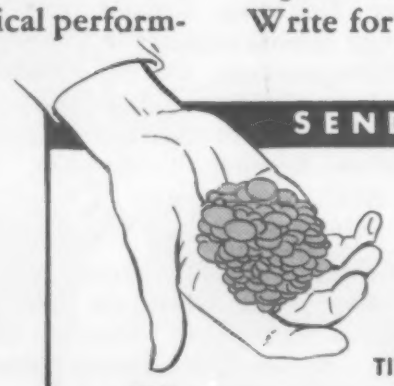
SILVER DOME Provides High Electrical Conductivity

ALUMINUM BASE Reduces Weight, Has Greater Heat Dissipation, Reduces Bouncing

Again General Plate pioneers in laminated metals . . . this time it is the new *Silver on Aluminum* Button...especially suited for heavy-duty contacts or large contacts. The silver surface gives better electrical performance. The aluminum makes the contact lighter-in-weight, permits larger contacts because it has high heat dissipation characteristics.

General Plate *Silver on Aluminum Buttons* reduce costs, too, because they replace expensive solid silver contacts. Moreover, all requirements can be met with these money-saving contacts. They are available in practically all regular laminated button shapes. Write for information and samples.

GENERAL PLATE DIVISION
of Metals and Controls Corporation
601 Forest Street, Attleboro, Mass.



SEND FOR SAMPLES TODAY

GENERAL PLATE DIVISION
of Metals and Controls Corporation
601 FOREST STREET, ATTLEBORO, MASS.

Gentlemen: Please send me complete information and samples of Silver on Aluminum Buttons.

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TITLE_____

FIRM_____

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Silicone News

DC SILICONES

Flying Jennys to Jets

In the days of the flying Jenny and the cow pasture airport, comfort was a luxury few airmen had time to consider. Keeping out of the tree tops was a more constant problem than keeping fingers from freezing. But in the sleek new airliners, passengers expect drawing-room comfort. That requires creative engineering because both high and low temperatures are involved and only such relatively new materials as the Dow Corning Silicones can take both extremes.

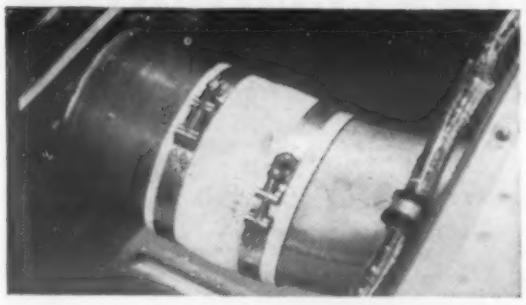

PHOTO COURTESY ARROWHEAD RUBBER CO.

Silastic-coated glass cloth heating duct seals withstand continuous long time exposure to operating temperatures between 350° and 400° F. in new Consolidated Vultee Convair-Liners.*

In designing the new Convair-Liner, Consolidated's engineers faced heating and ventilating duct conditions that would frizzle any conventional material; maximum temperature 450° F.; operating temperature, 350°-400° F.; internal air temperature, 250°-350° F.; internal pressure, 10 in. of water; misalignment, 1/8 to 1/4 inch; vibration from mild to extreme.

That's the problem Consolidated presented to Arrowhead Rubber Company of Vernon, California. In 10 days engineers at Arrowhead solved this problem with a combination of Silastic on glass cloth. Arrowhead also uses Silastic, the rubber-like silicone by Dow Corning to produce duct seals that have high performance records at temperatures from —89° to 450° F. and under pressures up to 150 p.s.i. in the newest army jets.

For the properties of Silastic phone our nearest branch office or write for pamphlet No. F5-BC.

*TRADE MARK REGISTERED U. S. PAT. OFF.

DOW CORNING CORPORATION
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Atlanta • Chicago • Cleveland • Dallas
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Dow Corning
FIRST IN SILICONES

News of...

ENGINEERS COMPANIES SOCIETIES

Goodrich Chemical Co. at its Avon Lake, Ohio plant as soon as facilities are completed. Trial quantities of the new plasticizers will be available within the next few weeks from the company's Avon Lake experimental station pilot plant, with large-scale production of the plasticizers scheduled for the second quarter of 1949.

The *Organic Coatings Div.* of *United Chromium, Inc.*, New York City, has announced the addition of baking synthetic enamels to its line of Unichrome Product Finishes.

A research contract has been awarded to the *New York University College of Engineering* by the Watertown Arsenal covering the development of titanium-carbon and titanium-nitrogen phase diagrams. The work will be under the direction of John P. Nielsen, associate professor of Metal Science.

A consolidation has been effected between the *Johnson Matthey Co.* and *P. R. Mallory & Co., Inc.* The new organization will be known as *Johnson Matthey & Mallory, Ltd.*, located at 110 Industry St., Toronto 15, Ont., Canada. Besides continuing to manufacture precious metal products for the industrial and jewelry trades, the new company will also produce the complete line of metallurgical products offered by P. R. Mallory & Co., Inc.

Societies

The *American Institute of Mining & Metallurgical Engineers* elected its national officers and directors for 1949 at a recent meeting. Dr. Lewis Emanual Young, a consulting mining engineer in Pittsburgh, is the new president. The two vice presidents of the Society are Augustus Braun Kinzel, president of the Union Carbide & Carbon Research Laboratories, and Philip Kraft, vice president of the Newmount Mining Corp.

A Central Ohio Management Executives Group of the *Gray Iron Founders' Society* was organized in Columbus, Ohio recently. Marshall B. Dewey, general manager of the Miller Foundry Co., was elected chairman of the newly formed group, and George H. Alten, Alten's Foundry & Machine Works, was made

AVOID COSTLY SHUTDOWNS DUE TO *CORROSION*...

SPECIFY

HAVEG

EQUIPMENT FOR

CORROSION RESISTANCE THAT'S MORE THAN SKIN DEEP

- Agitators
- Baskets
- Blowers
- Fume Duct
- Filters
- Kettles
- Piping
- Pumps
- Tanks
- Towers
- Many Others

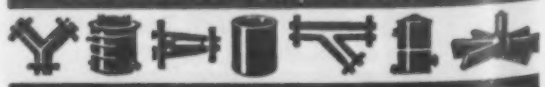
HAVEG is a molded structural material that is completely acid and alkali resistant throughout its entire mass . . . it is not a lining nor a coating!

Large size equipment can be molded at low cost in one piece without seams or joints and installation accomplished easily and economically.

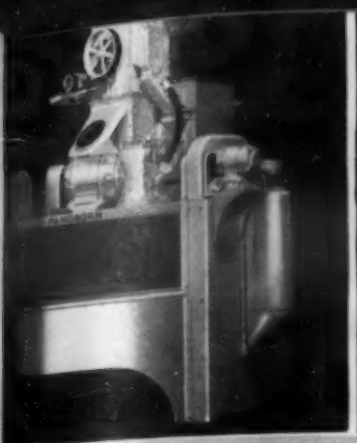
Send for Bulletin F-5 for complete design, engineering and application data.

HA-6-47

HAVEG CORPORATION
NEWARK 25, DELAWARE

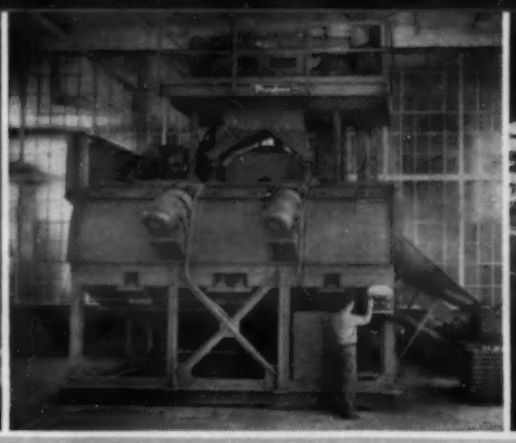


CLEVELAND 14 CHICAGO 11 HOUSTON 6 DETROIT 11 LOS ANGELES 13 SEATTLE

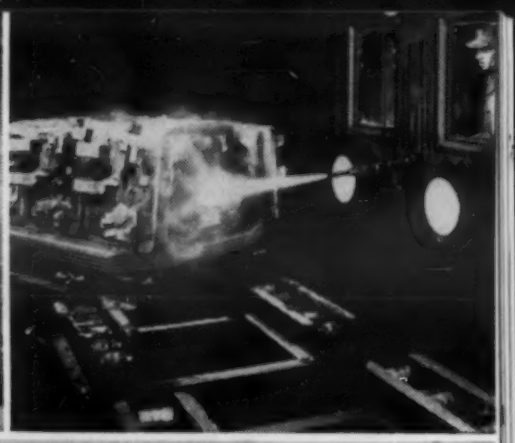


…born Rotoblast Tables for …continuous blast cleaning …available in many types and … For cleaning flat castings, …F Table . . . for castings …deep pockets, odd shapes …ertical surfaces, the LG . . . for simultaneous …g and cleaning, the LH …-Style" Table . . . for …l-purpose blast cleaning, …otoblast "Table-Room."

Pangborn Rotoblast Barrels for top efficiency and economy in batch cleaning methods also offer a wide variety of sizes to fill every specific batch-blast cleaning job. These machines are famous for their cost-slashing performance because of their exclusive rocker barrel action which turns the work under the Rotoblast stream for cleaning on all sides, surfaces and contours.



Pangborn Continuous-Flo Rotoblast Barrel has at last accomplished production line blast cleaning, uninterrupted and an integral part of continuous materials handling. This latest development in the centrifugal blast cleaning field by Pangborn has reduced cleaning costs . . . delivered cleaned castings 20 minutes after pouring . . . is operated solely by one man.



Pangborn Blast Cleaning Rooms. The Hydro-Sand Blast Room simultaneously blast cleans and removes cores, using a high-pressure impelled stream of sand and water manipulated by the operator from outside the room. Pangborn Air Blast Rooms (not illustrated) are custom-built to specifications to clean castings too large for Table or Barrel handling.

which of these Pangborn Blast Cleaning Machines fills your blast cleaning needs?

No matter what you require in blast cleaning machines, Pangborn has the right equipment for every job. Perhaps a Rotoblast* Table will solve the cleaning problem that may be troubling you now. On the other hand, your specific task might require a Pangborn Rotoblast Barrel, Continuous-Flo Barrel, Air Blast Room or Hydro-Sand Blast Room. But in any case you can be sure of getting faster, better, cheaper blast cleaning with the right Pangborn Equipment.

Pangborn Machines are serving vital roles in modern industry, speeding cleaning operations with better finishes at lower costs with less man-hours. Find out how your company can slash your overall cleaning costs with Pangborn Equipment. Send for the Pangborn bulletins that fit your needs. Just fill in the coupon below and mail to PANGBORN CORPORATION, 1403 Pangborn Blvd., Hagerstown, Maryland.

OVER 25,000 PANGBORN MACHINES SERVING INDUSTRY

…ite for these informative bulletins

PANGBORN CORPORATION
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Please send me the following bulletins:

☐ BARRELS ☐ TABLES ☐ ROOMS
☐ HYDRO-SAND BLAST ☐ DUST CONTROL

Name.....

Address.....

City.....

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Pangborn

* Trademark of Pangborn Corporation

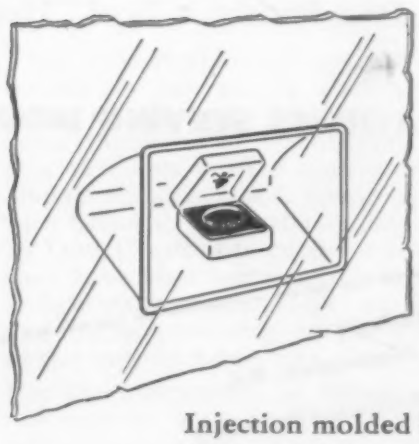
BLAST CLEANS CHEAPER with the right equipment for every job

WHAT'S NEW IN AUBURN Plastics

A new type of calculator keytop that adds much to the smart styling and functional design of the unit is molded by AUBURN for the Marchant Calculating Machine Company.

Molded of Tenite II by a double shot injection molding technique, the two-tone keytops are produced as one piece with nothing to wear off or come apart. Characters, in contrasting colors, are flush and cannot be effaced . . . and there are no surface depressions to gather dust.

The keytops are also molded in different colors with varying shapes to increase the operator's speed and accuracy.



A new idea in permanent, dust-proof window displays has been translated into plastics by AUBURN for the Niagara Lithograph Corp., patentee.

It is a small (approximately 7″ x 8″) transparent case designed to hold the merchandise, in its own open case, directly to the inside of the dealer's display window. Special cement applied to a groove molded into the flange on the open end makes a strong seal between window and case. Injection molded in a single cavity mold, it is an acrylic plastic, chosen for its stability at extreme temperatures, its imperviousness to sunlight and its comparative disinclination to attract dust particles.

AUBURN molds all types of plastics by any modern molding method. When you have a problem in plastics, AUBURN'S 73 years of experience is at your service.
Write: Auburn Button Works, Inc., 410 McMaster St., Auburn, N. Y.

Auburn Engineered Plastics

MOLD MARK

Auburn Button Works, Inc.

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News of...

ENGINEERS COMPANIES SOCIETIES

chairman of the Membership Committee.

A new Award Program to advance the progress of welded bridge design has been established by the *James F. Lincoln Arc Welding Foundation.* The competition opens Jan. 1, 1949 and closes June 30, 1949. Any engineer or designer who feels himself qualified to enter the contest is eligible for participation. A specified, welded highway bridge is the subject of the competition, and complete details of the rules and conditions are available from the James F. Lincoln Arc Welding Foundation, Columbus 1, Ohio. Wilbur M. Wilson, research professor of Structural Engineering of the University of Illinois, is chairman of the Rules Committee and the Jury of Award.

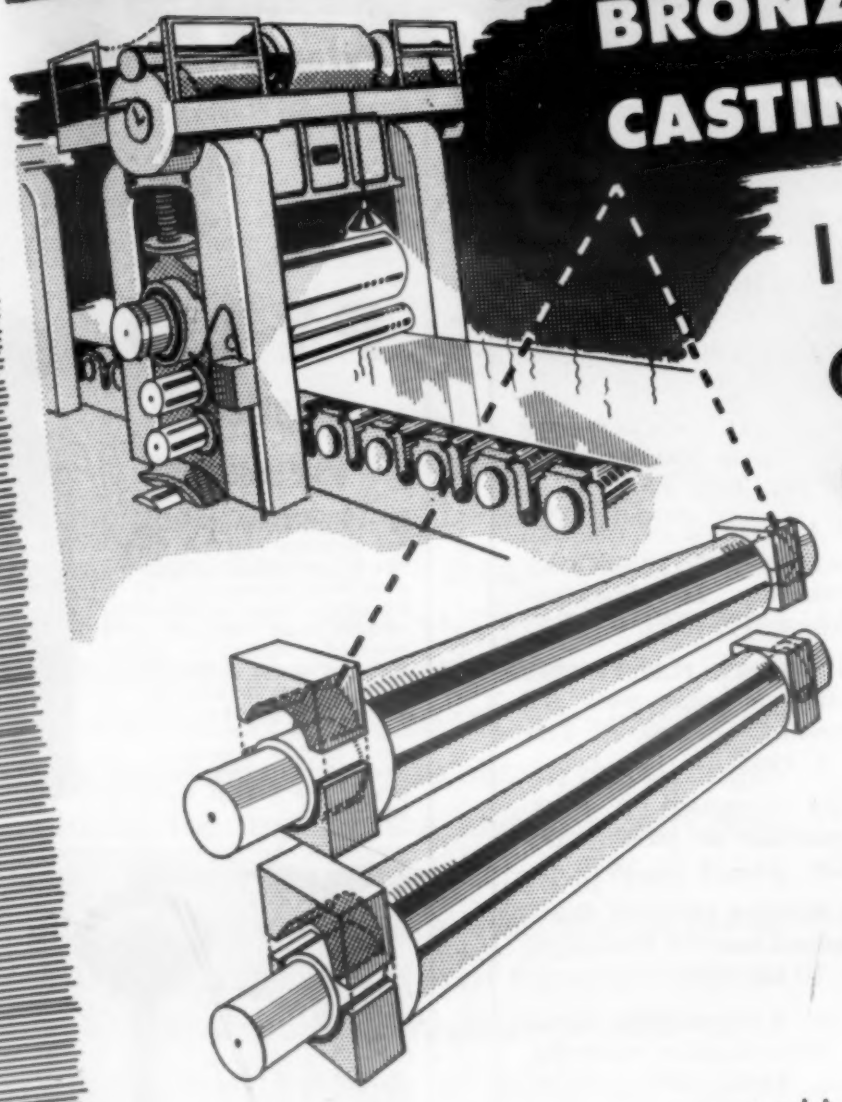
The *American Society of Mechanical Engineers* conferred its 1948 national honors and awards on noted inventors and men of science at its recent annual meeting. Among those receiving honorary membership in the Society were Dr. Lyman J. Briggs, director emeritus of the Bureau of Standards; Oscar A. Leutwiler, professor emeritus of the University of Illinois; and George I. Rockwood, chairman of the board of trustees of Worcester Polytechnic Institute and former head of the Rockwood Sprinkler Co.

Final Committee appointments for the Western Metal Congress and Exposition, to be held Apr. 11-15, 1949 in Los Angeles, Calif., have been announced by the *American Society for Metals.* E. R. Babylon, of the Kaiser Co., heads the General Committee, which will direct the overall policy of the Exposition. The two vice chairmen of this Committee are James B. Morey, of International Nickel Co., Inc., and S. R. Kallenbaugh, of the Timken Roller Bearing Co. W. J. Parsons, of the Pacific Scientific Co., will serve as secretary. Other Committee chairmen include Harry H. Beyma, Kaiser Co.—Attendance Committee; Edgar Brooker, U. S. Spring & Bumper Co.—Cooperating Societies Committee; W. W. Farrar, Farbest Corp.—Entertainment; John E. Wilson, Climax Molybdenum Corp.—Registration; R. B. Grossman, Southern California Gas Co.—Exhibits; Dr. W. F. Nash, Naval Ordnance—Program; and W. E. De Ridder, General Metals Corp.—Publicity.

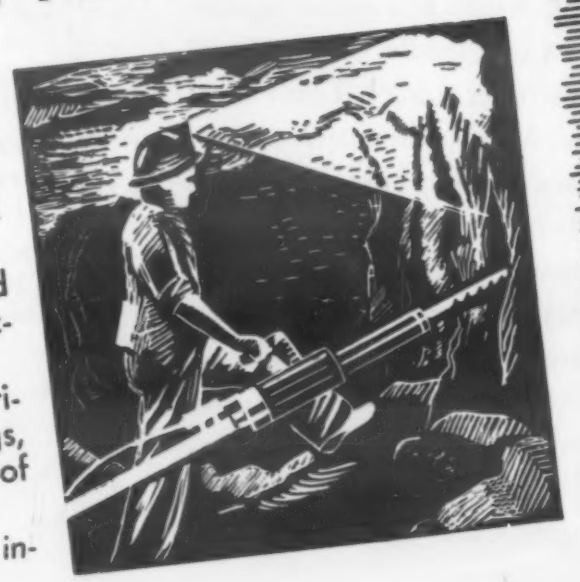
The *Society of the Plastics Industry, Inc.* has prepared a 16-mm. sound and color film demonstrating the development of the research project in plastics sponsored by the Plastics Materials Manufacturers' Assn. in the laboratories of the Massachusetts Institute of Technology. This film is available to those groups that are interested.

THE METAL INDUSTRY REQUIRES

BRONZE CASTINGS



In All Operations From Mine to Finished Product



Cast Bronze roll neck bearings are required in the production of wrought metal products. Cast bronze withstands best the tremendous pressures and relatively high temperatures to which roll neck bearings are subjected.

Bronze is unique because it is used as an end product as well as a necessary tool in the production of other metal goods.

Mining equipment . . . milling equipment . . . fabricating equipment . . . rely upon cast bronze bushings, bearings, valves, etc., in the efficient production of metals from Mine to Finished Product.

Cast Bronze meets the requirements of both industry and consumer.

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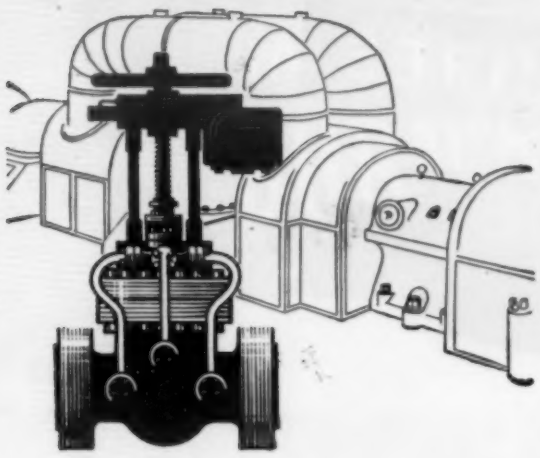

high pressure and high temperature

Not so many years ago, designers shunned gray iron for high pressure and high temperature usage. This is all changed — such castings are now freely specified.

Molybdenum has made possible this type, and many other types, of high quality cast iron.

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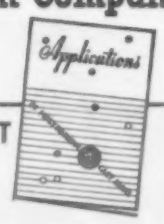

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Meetings and Expositions

AMERICAN CHEMICAL SOCIETY, analytical symposium. Pittsburgh, Pa. Jan. 20-21, 1949.

INDUSTRIAL FURNACE MANUFACTURERS ASSOCIATION. Cleveland, Ohio. Jan. 24-25, 1949.

INSTITUTE OF THE AERONAUTICAL SCIENCES, annual meeting. New York, N. Y. Jan. 24-27, 1949.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, annual meeting. Chicago, Ill. Jan. 24-27, 1949.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, winter general meeting. New York, N. Y. Jan. 31-Feb. 4, 1949.

STEEL FOUNDERS' SOCIETY OF AMERICA, annual meeting. Chicago, Ill. Feb. 9-10, 1949.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, annual meeting. San Francisco, Calif. Feb. 14-17, 1949.

AMERICAN SOCIETY FOR TESTING MATERIALS, committee week and spring meeting. Chicago, Ill. Feb. 28-Mar. 4, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, passenger car meeting. Detroit, Mich. Mar. 8-11, 1949.

AMERICAN SOCIETY OF TOOL ENGINEERS, annual meeting. Pittsburgh, Pa. Mar. 10-12, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, transportation meeting. Cleveland, Ohio. Mar. 28-30, 1949.

SAFETY CONVENTION AND EXPOSITION, annual meeting. New York, N. Y. Mar. 29-Apr. 1, 1949.

SOCIETY OF AUTOMOTIVE ENGINEERS, aeronautic and air transport meeting. New York, N. Y. Apr. 11-13, 1949.

AMERICAN SOCIETY FOR METALS, Western metal congress and exposition. Los Angeles, Calif. Apr. 11-15, 1949.

MAGNESIUM ASSOCIATION, annual meeting. Chicago, Ill. Apr. 14-15, 1949.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, National Open Hearth Steel Committee annual meeting. Chicago, Ill. Apr. 18-20, 1949.

INTERNATIONAL ACETYLENE ASSOCIATION, annual convention. Pittsburgh, Pa. Apr. 25-26, 1949.

SOUTHERN MACHINERY & METALS EXPOSITION. Atlanta, Ga. Apr. 25-28, 1949.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Oil & Gas Power Div. conference. Chicago, Ill. Apr. 25-29, 1949.

WHY GUESS THE TEMPERATURE . . . When you can SEE it!

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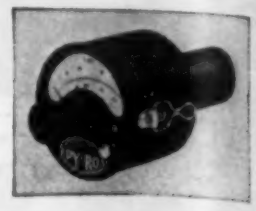

Tells spot temperatures instantly in heat-treating furnaces, kilns forgings and fire boxes. No thermocouples, lead wires or accessories needed! Temperature indicated on direct-reading dial at a press of the button. Any operator can use it. Two double-ranges for all plant needs. **Write for FREE Catalog No. 100.**

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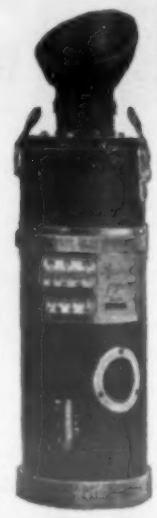
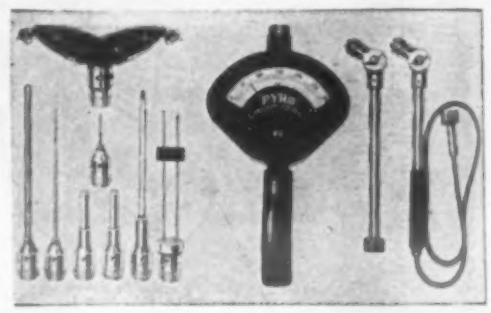


Determines temperatures of minute spots, fast-moving objects and smallest streams — at a glance! No correction charts or accessories needed. Easy to use—weighs only 3 lbs. Special types available to show true spout and pouring temps. of molten ferrous metal measured in open. Five temp. ranges. **Write for FREE Catalog No. 80.**



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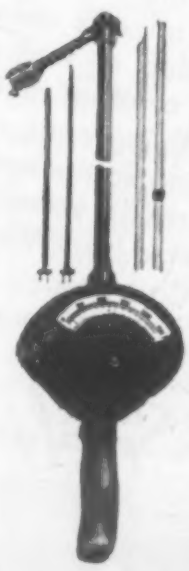
The **NEW PYRO** Surface Pyrometer handles all surface temperature measuring jobs. Has 8 types of thermocouples; all interchangeable in seconds with no recalibration or adjustment. Automatic cold end compensator, shock, moisture and dust proof. Accurate, big 4¾" indicator. Available in 5 temperature ranges. Get FREE Catalogue No. 160.



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When You Use a *FORGING*, You Have Done All That Can Be Done to Forestall Unpredictable Parts Failures

Macro-etch through longitudinal cross-section of pinion rack used on power shovel shows fiber-like structure in rack teeth which provides maximum resistance to wear, and strength and toughness for shocks and stresses occurring continually when in use. This fiber-like structure is common in all high quality forgings.

THERE IS NO SUBSTITUTE for the strength and toughness inherent in the forged fiber-like flow-line structure of forgings. The forging method of fabricating parts in closed impression dies directs, controls and concentrates the fiber-like flow-line structure of metals at points of greatest shock and stress. In forgings you obtain the strength and toughness for unrelenting and uninterrupted performance. When you use a forging, you have done all that can be done to forestall the failure of parts and to protect the user of your equipment from unpredictable emergencies. Forgings provide rapid assembly of complex parts as by welding; forgings permit reduction of dead weight because maximum strength and toughness are obtainable in lighter sectional thicknesses. The metal quality and cost-reducing advantages obtainable in forgings cannot be equalled or duplicated. Recheck every stressed part in your equipment, and consult a forging engineer about possibilities for reducing costs of machining and finishing, speeding up assembly and improving performance. Only a forging engineer can inform you fully regarding the many advantages of forgings.

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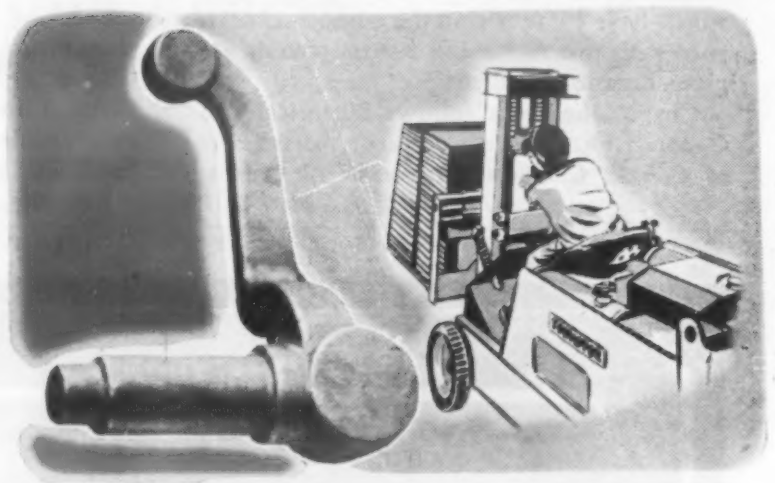
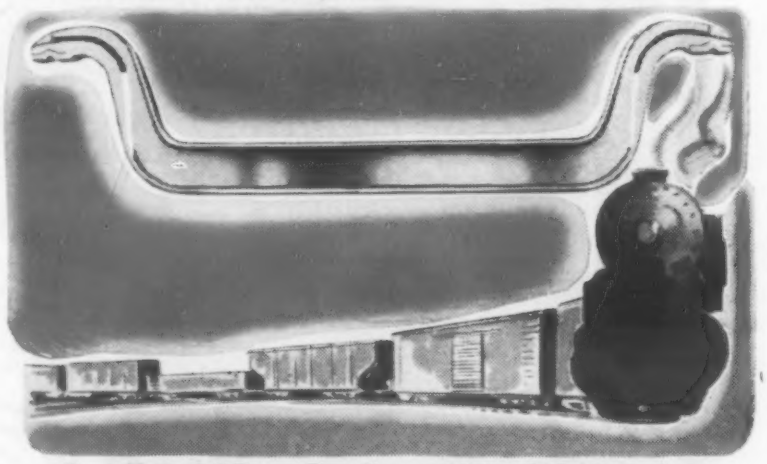


The steering mechanism of Towmotor lift trucks must operate smoothly at all times and under all kinds of loading without failure. To insure such trouble-free performance, the engineer designed this steering knuckle to be a forging, thereby obtaining a greater factor of safety which is so essential in materials handling equipment.



Drop Forged I-Beam Equalizer weighing 405 lbs. replaces an 800 lb. unit on freight cars. This illustrates how forgings reduce dead weight, yet provide a greater factor of safety that is so important in railroad operation. This drop forged I-Beam requires less machining and processing, and scrap loss is almost totally reduced because forgings are unusually free of concealed defects.

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☐ Booklet on "Metal Quality — Hot Working Improves Properties of Metal."

☐ "Drop Forging Topics" which presents numerous end use applications of forgings.

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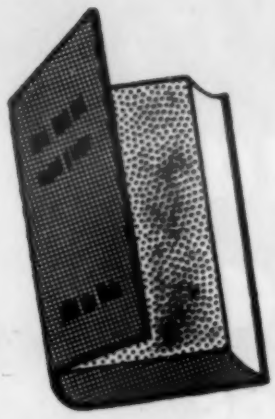

BOOK REVIEWS

Cobalt

COBALT — A.C.S. MONOGRAPH NO. 108. *By Roland S. Young. Published by Reinhold Publishing Corp., New York, 1948. Cloth, 6 x 9¼ in., 181 pages. Price $5.00.* This is the first high-ranking technical book yet published on cobalt, and for that reason alone fills an important gap. Data on the chemistry and metallurgy of cobalt have been assembled and reviewed critically. Unpublished features and developments which have come within the author's experience with this metal and its compounds are given here for the first time.

Chapter headings follow: Historical and General; Occurrence of Cobalt; Metallurgy of Cobalt; Chemical Properties of Cobalt; Physical and Mechanical Properties of Cobalt; Cobalt in Ferrous Alloys; Cobalt in Nonferrous Alloys; Cobalt in Powder Metallurgy; Electroplating of Cobalt; Cobalt Compounds in the Glass and Ceramic Industries; Catalytic Behaviour of Cobalt; Biological and Biochemical Relationships of Cobalt; and Analysis of Cobalt.

Metallurgical Careers

YOUR CAREER IN THE METALLURGICAL PROFESSION. *By John W. W. Sullivan. Published by American Society for Metals, Cleveland 3, Ohio, 1948. Heavy paper, 5½ x 8¼ in., 96 pages.* Designed to help high school students determine if they are fitted for and interested in metallurgy as a career, this booklet describes the opportunities and satisfactions that can be found. The importance, interest, continual expansion of metallurgy, stability, and usefulness to civilization are discussed.

The section on Metallurgists at Work is devoted to the various types of work open to metallurgists. Under Frontiers of Metallurgy are listed many of the problems which are still a challenge to the profession. Industrial Training and Salaries, and Building Your Career contain vital information and advice.

Case histories of the careers of several young metallurgists are included.

Other New Books

SOURCES OF ENGINEERING INFORMATION. *By Blanche H. Dalton. Published by University of California Press, Berkeley and Los Angeles, Calif., 1948. Cloth, 6¼ x 9½ in., 109 pages. Price $4.00.* Guide to engineering literature and data.

PRACTICAL CONSIDERATIONS IN DIE CASTING DESIGN. *Published by the New Jersey Zinc Co., New York 7, 1948. Cloth, 6 x 9¼ in., 246 pages. Price $3.00.* Specific designs and applications of die castings of all alloys now in use, and the practical considerations involved in their design are discussed.

ALUMINUM ALLOYS AND MILL PRODUCTS. *Published by Reynolds Metals Co., Inc., Louisville 1, Ky., 1948. Cardboard, 5¾ x 8¾ in., 162 pages. Price $1.00 (free to engineers, designers and technical men who request it on company letterhead).* 163 tables of data and an explanatory text give information on aluminum alloys and mill products.

TURNING AND BORING PRACTICE—THIRD EDITION. *By F. H. Colvin & F. A. Stanley. Published by McGraw-Hill Book Co., Inc., New York, 1948. Cloth, 6¼ x 9¼ in., 531 pages. Price $4.75.* New material has been added on mandrel and taper work in lathes, on precision boring where extreme accuracy is required, on boring bars for special work, and on carbide tools for different classes of work.

PRECISION MEASUREMENT. *By Jack Johnson. Published by Pitman Publishing Corp., New York, 1948. Cloth, 6¼ x 9¼ in., 181 pages. Price $3.00.* Practical down-to-earth problems that confront the inspector in his tool work are presented, and the solutions are carried through step by step.

THE HISTORY OF BASIC METALS PRICE CONTROL IN WORLD WAR II. *By Robert F. Campbell. Published by Columbia University Press, New York, 1948. Cloth, 6¼ x 9 in., 263 pages. Price $3.25.* Attempts to evaluate critically and objectively the measures undertaken by the OPA to regulate the prices of the basic metals—iron, steel, aluminum, copper, lead, zinc and the scrap metals. Based on OPA records and memoranda.

PRACTICAL ARC WELDING. *Published by Hobart Brothers, Box EW-82, Troy, Ohio, 1948. Fabrikoid, 5½ x 8 in., 516 pages. Price $2.00.* Covers arc welding and its applications. Illustrations of actual welding jobs, tables and charts of useful data are included.

ELECTRONS, ATOMS, METALS AND ALLOYS. *By William Hume-Rothery. Published by Louis Cassier Co., Ltd., London, S.E. 1, England, 1948. Cloth, 5½ x 8¾ in., 377 pages. Price 25s. 6d.* The author discusses what the electron theory of the structure and properties of metals and alloys is about, in the form of a dialogue between an older metallurgist and a young scientist.

A.S.T.M. STANDARDS ON COPPER AND COPPER ALLOYS. *Published by American Society for Testing Materials, Philadelphia 3, Pa., 1948. Paper, 6 x 9 in., 504 pages. Price $4.35 (Cloth binding, $5.00).* All the Society's specifications relating to copper and copper alloys are included in this revised and expanded compilation.

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- **AND WHOSE EQUIPMENT**

Materials & Methods is the only publication in the product-manufacturing field that is *exclusively* concerned with the answers to the question—which material should be used, and by what method should it be processed?

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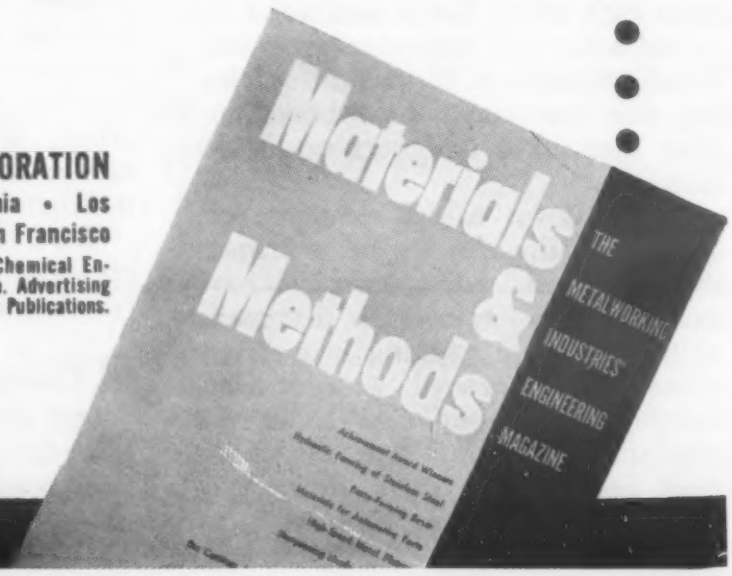

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The Last WORD

by FRED P. PETERS, Editorial Director

Why?

Every book should have a preface and every declaration a prologue, each stating in impressive terms the lofty purpose of the piece. The 3-fold and not necessarily lofty purpose of the new proprietor of this page, in keeping with the page's name, will be (1) to bring you the most up-to-date bits of this-and-that, the latest, *viz:* "the last word"; (2) to present the final rebuttal in any passing argument (here "the last word" is used in its more familiar or marital sense); and (3) to fill the last page of Du Mond's Meaty Materials Magazine with these last gasping words so that he, at last, can call "start the presses" and send millions —well, thousands anyway—of copies of the world's only materials engineering magazine to their well-thumbed fate.

The difference between Billy Rose and us is that while he offers "Wine, Women and Words", all you'll ever find here will be words, just words . . . Sorry.

Let's Educate, Not Castigate, Designers

A couple of months ago during our stubborn occupancy of the main "editorials" page of this journal we commented on the things that designers and materials engineers could learn from each other. Since then we've received some stiff statements from materials engineers of various titles claiming that they could draw better any time than most designers can select materials.

Boiled down to its elements, the chief complaint that engineers primarily concerned with materials have against design engineers is that many of the latter are working in a never-never land populated with obsolete handbooks and old data about the standard engineering materials of 20 years ago, so that their designs are likely to be overstuffed, unimaginative applications of a few old standbys intermixed with unsound uses of one or two brand new, highly glamorized materials. The vast area in between, in which are found all the new subdivisions and modifications of the old materials, the improved grades and properties, the life-giving processing treatments, the countless special finishes for various engineering purposes, the thoroughly established alternative fabricated materials and types of parts —all developed in recent years—is ignored in favor of the very old and the very very new.

These materials engineers say that as a result the designers' materials choices, often presented in excessively general terms for lack of specific data, have to be revised or thrown out entirely, and that in many shops the prestige of design engineers—especially among plant men who subsequently have to put the materials through their processing paces—is falling dangerously low.

Maybe we're wrong in trying to get materials engineers and designers to share each other's problems and information. There certainly is abundant evidence that the requirements of *materials* engineering are becoming so specialized that the broad, many-sided activity of the *design* engineer leaves little room or time for proper attention to them. But we also do know several first-class design engineers who are at the same time able materials engineers, and we think there could be many others, if they would all seek the needed information efficiently and in the right places.

We'd like to hear from some designers about this. And we'll promise them "the last word," too, when we do!

Of Photographs and Phonographs

Our friends were kinder than ever this year and showered us with cards—some beautiful, some stimulating, some entertaining, but all of them most gratefully received. The increasingly numerous knights of the camera sent along the largest proportion yet of photographic greetings. Basically religious messages were also (and satisfyingly) more evident than in the past.

One of the nicest "cards" was musical—an excellent phonograph record by the employees' chorus of one of our better known furnace builders, with tempo and temperatures, tones and zones all beautifully synchronized.

Anyway, thanks for all your cards!

January Jottings

Note, please, the new 3-column makeup in the feature article section, designed to match this journal's faster pace, also to be easier on your eyes. . . . If you want to get excited about something technical, listen sometime to Herb Hollomon of GE explain many familiar metallurgical phenomena as due to nucleation and growth, an hypothesis about to become a theory. . . . Or have Bob Talmage, powder metallurgy consultant, do some pencil work on the economic benefits accruable to those product manufacturers who really design parts for production from powder and then make them themselves. . . . The increased powder parts volume, he says, will be at the expense of other methods rather than of the present powder parts contract manufacturers. . . . Sam Hoyt is hard at work on his bigger and better second edition of the "Metals and Alloys Data Book," already a technical best-seller. . . . And speaking of best-sellers, the bon mot of the month on publishers' row is this: *Eisenhower, the man who'd rather write than be president!*

In '49

In '49 the sun will shine
With certainty we'll state.
The earth will turn and lovers yearn
Just as in '48.

But that's the last; we'll not forecast
Another "thing to come."
The price of zinc? Will markets shrink?
Uh-uh . . . No sir . . . We're mum!

Of course, we *know* how things will go—
Just as we did last Fall
When glimmered bright Tom Dewey's light
Deep in our crystal ball.

We'll only say, we *hope* each day
Will bring you something fine,
And what you plan will turn out grand
In 1949!